
FERIO TEGO

Jno Phillips

AN

E S S A Y

ON

S H O O T I N G.

Some there are who hardy range the purple heath
Or naked ſtubble, where from field to field
The ſounding coveys urge their lab'ring flight,
Eager amid the riſing cloud to pour
The gun's unerring thunder.——

ARMSTRONG.

AN

ESSAY

ON

SHOOTING:

by John Acton

CONTAINING

The various Methods of forging, boring, and dreffing Gun Barrels, practifed in France, Spain, and England, and the different Proofs of Barrels employed in thofe Countries; with Remarks—An Inveftigation of the Caufes of Recoil, and of Burfting; with Propofals for preventing or remedying them—An Inquiry into the Effects of the Length, Bore, and Charge, upon the Range, &c. of the Piece—Remarks on the Properties and Action of Gunpowder, and upon the Articles of Shot, Wadding, &c. &c.—Inftructions for attaining the Art of Shooting—The Methods of training Pointers—And a fhort Defcription of the Game of this Country, as connected with the Amufement of Shooting.

The whole interfperfed with fummary Obfervations on the various Subjects of the Sport.

THE SECOND EDITION.

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PREFACE

TO THE

FIRST EDITION.

THE total want of a treatiſe in the Engliſh language ſuch as the preſent, poſſeſſing either ſcience or extent, is the principal inducement the author has, in offering to the public what he originally intended only for his own uſe and amuſement. The idea of collecting and arranging the information he poſſeſſed upon this ſubject, was firſt ſuggeſted by the peruſal of an ingenious publication that has lately appeared in France under the title of "La Chaſſe au Fuſil."

Of this valuable work he has availed himſelf conſiderably, as will be ſeen by a compariſon of it with the

prefent treatife; but whilft he acknowledges his obligations to Monf. Magné de Marolles, the ingenious author, for much entertainment and inftruction, he muft at the fame time obferve, that if this Effay is found to poffefs any merit, a confiderable portion of it is due to the perfonal experience of the writer: and as he has fpared neither trouble nor expence in acquiring from the beft workmen, every poffible information that relates to the manufacture of gun-barrels, &c. he trufts that it will not be found unworthy the attention of perfons who profefs themfelves attached to the amufement of fhooting.

The fports of the field were the great delights of our anceftors; nor could any amufements be fo congenial to the difpofitions and habits of a brave and warlike people, as thofe which ferved at once to invigorate the body and animate the mind.

> By chafe our long-liv'd fathers earn'd their food,
> Toil ftrung their nerves and purified their blood.
>
> Dryden.

The bow and arrow appear to have been among the earlieft arms of chafe and war in every country; and however rude and artlefs they may now appear, the plains of Creffy and of Agincourt will for ever bear

teſtimony to their efficacy in the hands of Engliſh bowmen.

The reſtleſs and inſatiable mind of man, however, could not remain ſatisfied with weapons of ſo ſimple a conſtruction: the powers of invention were therefore tortured, in order to deviſe ſomething more effectually deſtructive; but until Chemiſtry lent her aid to the vindictive ſpirit of the human race, the utmoſt efforts of mechanical ingenuity reached no farther than the croſs bow, and there ſeemed to be wholly at a ſtand.

The diſcovery of gunpowder opened an entirely new field, and gave an almoſt boundleſs ſcope to the exerciſe of genius and of induſtry; with what ſucceſs theſe have been employed in the improvement of fire-arms, few of our readers require to be informed.

It would ſtill, however, be a ſubject of much curious reſearch, and not without its uſe, to trace the progreſs of invention in the various arms of chaſe employed throughout Europe; to mark the gradual improvement of each, from the ſpear to the croſs-bow, and from the clumſy match-lock to the elegant fowling-piece; and to determine the comparative excellence of different nations and different individuals in their manufacture and uſe.

In this enquiry the tribute of praiſe might perhaps be

found due to our own country; and whilſt we challenged the world to rival our artiſts, we might be laudably vain of the reſpective qualities and ſuperior ſkill of a Robin Hood, and a Colonel Thornton.

Such an inveſtigation, however, beſides that it would much exceed the bounds of an eſſay, belongs more properly to the antiquarian, than to the ſportſman; we ſhall therefore decline the attempt, and, for ſuch information, refer the curious to the ingenious treatiſes of Monſ. de Marolles and Captain Groſe.

PREFACE

TO THE

SECOND EDITION.

TWO years have now elapſed ſince the firſt edition of this work made its appearance; an early ſale of which, the importunities of friends, and the aſſurances of many ſportſmen that a ſecond edition was in demand, ſome time ago induced the author to think of reprinting the book. During this period he has taken occaſion to improve the matter; for, in the courſe of inveſtigation and experiment, many things had occurred to him which had been omitted, or miſtakenly treated in the original publication, and many inaccuracies had been pointed out by others. He has, therefore, endea-

voured to remedy the defects which occurred or were ſuggeſted to him; and the additions made to the work, particularly thoſe which relate to the properties and action of gunpowder, are ſuch as ſeemed in ſome degree neceſſary to juſtify a ſecond edition, and to make the whole more acceptable to ſportſmen in general.

The aſſiſtance of gunſmiths eminent in their profeſſion has frequently been ſolicited by the author, and has been as often proffered: promiſes however are generally found to be more readily made than performed; the ignorant wrap themſelves up in the *profound ſecrets of the trade*, and thoſe who have the moſt ability to lend their profeſſional aid, ſeldom have leiſure to give it, a circumſtance the more to be lamented by the author, becauſe, aſſiſted by ſuch, the preſent work might have been rendered more worthy the attention of ſportſmen, by whom we truſt no apology will be deemed neceſſary for again conducting them to the forge, the place from whence the chief inſtrument of their diverſion ſprings.

Still, with all the additions that have been made, whether by perſonal induſtry, by what experience has furniſhed, or the knowledge of fellow ſportſmen ſuggeſted, the author feels the work to be yet very imperfect. Experience, indeed, as well as experiment, has enabled

him

him to correct a few errors; but the whole has otherwise served only to convince him that he knows less of the subject of his treatise, than he imagined he knew when he before offered it to the public.

Conscious of this, the author now requests a communication, through the bookseller, of any information which experience or professional knowledge may be able to furnish, of any hints for the improvement of the work, or of any censure of its inaccuracies. If therefore what is now offered to the public, shall be a second time so far approved as to encourage an attempt to render it more worthy of notice, the advantage which may be derived from any such communication, will be made use of for that purpose, and acknowledged by the author.

The ideas suggested in the following sheets, respecting the shot of fowling-pieces, contrary to the opinion received and established among gunsmiths (a set of men, who, by the way, have little or nothing to do with the *manufacture* of the most important part of the instrument), may be termed, not improperly, the *Metaphysic of the Art.*

The forger and the gunsmith together complete the instrument of the chase: but the sportsman who applies it to its proper use, and who studies its effects with the spirit

ſpirit of curioſity and obſervation, without any kind of doubt, has the right to give his ſentiments, and to propoſe the reſults of his experiments.

The author begs to be underſtood, that what he has ſaid in the courſe of the work, reſpecting the fabrication of the various parts of fowling-pieces, is not intended for manufacturers; he has only endeavoured to inform the ſportſman in what manner the inſtrument to which he ſo eagerly attaches himſelf in its uſe, is made, and of which ſo many perſons are completely ignorant.

And as to the utility of thoſe parts of the preſent work which relate to the practice of the chaſe, the author has only to ſay, that he never pretended to write for finiſhed ſportſmen, or for thoſe who make ſhooting their principal occupation and amuſement; the daily experience of ſuch muſt ſuggeſt much more than he has dared to ſet down. Thoſe practical obſervations are intended principally for ſuch as are in the infancy of the art: but he ventures to flatter himſelf, that both the one and the other may find wherewithal to amuſe and inſtruct. For the practical part of the ſubject may be conſidered, in ſome degree, as a matter of ſcience; and it may be ſuppoſed that thoſe who excel in the art of ſhooting, may poſſeſs the knowledge of certain points, the whole of which being digeſted into a body of rules

and

and inſtructions, might form an elementary work, both uſeful and agreeable to ſportſmen of every claſs.

The author, however, has to regret that he is not as yet competent to form ſuch a work: but the frequent practice of a ſport which is his chief amuſement, may, one day or other, enable him to offer ſuch to the public, along with thoſe other additions which enquiry, experiment, or friendly communication may at a future period put it in his power to make to the work in general.

INTRODUCTION.

THE love of ſporting ſeems to be inherent in the human race; the wants of the individual on the one hand, and his amuſement on the other, prompt him to the chaſe. In its exerciſe, it calls forth the nobleſt exertions of the man, it engages all his faculties; and in purſuit of this mimic war, he is at once the hero and the monarch of the fields.

Although humanity, particularly in modern times, ſeems to ſhrink at the practice of the chaſe; yet in times the moſt enlightened, it has found its advocates. Poetry hath conſecrated its eulogies. Hiſtory hath ennobled her pages with the names of warriors formed under its laws. From it,

natural

natural hiſtory hath derived aſſiſtance. Sages have recorded its inſtitutions. On the ſame lyre, the Genii of the woods celebrate the children of Mars and Latona; and conquerors, accuſtomed to dictate the rules of war, have not diſdained to form the precepts of the chaſe.

Greece, the country of arts, of ſcience, and of genius, in the brighteſt days of her glory, conferred on ſportſmen the ſame homage that ſhe paid to the athletæ in the immortal games; whilſt the Muſes of Athens ſung in heavenly verſe the myſteries of the chaſe.

The Romans, conquerors of Greece, kindled, at the altar of her genius, that taper which afterwards conducted them to the light of ſcience. They ſung in honour of the Gods who preſided over the ſports of the field, and taught their intrepid youth to declare war againſt the inhabitants of the woods. Horace, the poet of the Graces and the painter of Reaſon; the ſublime Virgil, and the tender Ovid, have each of them ſoothed the labours of the hunter with his

his mellifluent ſtrains. The tranquil days of Auguſtus ſaw entire poems ſpring up to encourage its ardour; and whilſt the arts themſelves loſt their ſplendour, the chaſe continued to receive from poetry her accuſtomed tributes, even under the reign of emperors, who, notwithſtanding the obliquity of their natural diſpoſitions, ſtill appeared to intereſt themſelves in the cultivation of the ſciences, and the general intereſts of mankind.

Europe, after the irruption and conqueſts of the northern race, was for a long time enveloped with the clouds of ignorance. But the dawn of ſcience and the light of reaſon had no ſooner given day to Gothic barbariſm, than the chaſe partook of their enlivening rays, and mankind again delivered themſelves up to the faſcinating ardour of its purſuit.

The exerciſe of the chaſe is, in truth, ſo noble in itſelf, that the greateſt monarchs of the earth have authorized it by their example; in all ages it hath occupied the leiſure of heroes themſelves; with them,

the pleaſures of the chaſe ſucceeded the toils of war: it is the proper ſchool of the ſoldier; it accuſtoms him to fatigue, it prepares him for aſſault, it ſuſtains and ſeconds the courage of the man; in it is found the beſt relaxation from the cares and buſineſs of life; it is the only recreation without effeminacy, and the only one which beſtows pleaſure on its votary without a portion of ennui. To enjoy the converſe of his own boſom, to ſteal from the importunities of others, to retire from the vapid amuſements of the age, man has need of ſolitude; what ſolitude then is there more varied, or more animated, than that which the chaſe affords? what exerciſe more wholeſome for the body? what repoſe more ſoftening to the mind?

Jam undique ſilvæ et ſolitudo magna cogitationis incitamenta ſunt.

Experieris non Dianam magis montibus quam Minervam inerrare.

C. Plin. Sec.

In the preface to the former edition of this work, a hint was thrown out to antiquarians

quarians in general, that it might be a ſubject of curious reſearch, to trace the progreſs of invention in the various weapons which were made uſe of in the chaſe, before the invention of fire-arms. We ſtill think the ſubject worthy of enquiry; and the more ſo, when we conſider the ſuperficiality and frequent inaccuracy of thoſe works which have hitherto treated of it. In theſe days, when invention ſeems to be exhauſted, when new topics are no longer to be found, and when, in conſequence, we ſee the firſt literary abilities employed in gleaning up the ſcraps of former ages, poliſhing them from the ruſt of antiquity, and carefully ſeparating the finer particles from thoſe more groſs, we are perſuaded, that, with a ſmall part of that poring labour uſually beſtowed on ſuch topics, a very curious and entertaining collection of eulogies, poems, inſtructions, rules and laws, relating to the various ſubjects of chaſe, in all ages, and in the countries of which we have ſufficient account to extract materials, might be formed. To ſpeak only of our own country; ſince we

know that the ſports of the field were always congenial to the breaſt of a Briton, little doubt can be entertained, that his favourite and predominating amuſement may have been ſung in ſtrains of poetry worthy redemption from the muſty ſhelf of antiquity, and which, from ſuch a reſearch, might once more ſee the face of day, to the honour, not only of the ages in which they were written, but of the author who compoſed them, and to the fame and credit of him who ſhall be ſo fortunate as to reſtore them to the loſt pages of literature. Will not the example of Dr. Percy excite the labours of ſome one?

To carry the conſideration farther, ſuch an enquiry might be extended to aſcertain the preciſe period when the croſs-bow ſucceeded to the feats of archery, and the epocha when that more complex inſtrument, in its turn, gave place to the ſuperior effect of the fowling-piece—points not yet ſettled with ſufficient accuracy.

In the comparative excellence of the two laſt inſtruments of chaſe, the fowling-piece, without

without doubt, poſſeſſes great advantages over the croſs-bow; it is more eaſily managed, it is more expeditious, as well as more deſtructive in its effects; but ſtill the croſs-bow muſt be admitted to poſſeſs one very ſuperior quality, that of killing without any conſiderable degree of noiſe, and thereby alarming the game—a circumſtance much complained of by ſportſmen in thoſe times; for it appears by ancient authors, that, upon the introduction of the arquebuſe in particular countries, the noiſe made by the diſcharge had ſo frightened and diſperſed the game, particularly the *beaſts* of chaſe, that they were become very ſcarce in thoſe diſtricts where the arquebuſe was uſed.

Before the invention of fire-arms, the croſs-bow was the principal inſtrument in the hands of ſportſmen, and in much more general uſe than the bow and arrow, of which it is a modification, and over which it was found to poſſeſs the advantage of carrying, both to a greater diſtance, and with more certainty. Beſides, the ſportſman could adjuſt *bolts* of different dimenſions to

it, according to the ſpecies of the game he was purſuing. We may thence imagine what accuracy of aim was required in the croſsbow-man, ſince, to ſhoot with that inſtrument, was the ſame, at that time, as firing a ſingle ball with a fowling-piece now: and as he never ſhot his *bolt* at a flying, and but very ſeldom at a running object, we are aſtoniſhed to think what ſtrength and nicety of viſion muſt be required to diſcover the game on the ground, and what addreſs and precaution he muſt poſſeſs, to ſupply the defects of his inſtrument, compared with thoſe uſed at the preſent day.

The croſs-bow, however, ſeems to have been in uſe after the invention of the arquebuſe, and even when this laſt had been brought to ſome degree of perfection, and was rendered more manageable, compared with their firſt and original form. It appears that it was not until towards the end of the ſixteenth century, that this inſtrument was wholly diſuſed; at which time, the arquebuſe was brought to ſuch

perfection, as to enable the sportsman to shoot flying: but the precise epocha of this circumstance would with difficulty be ascertained.

The origin of the invention of the arquebuse (or by whatever name it was first called) would also be a subject of curious investigation, together with the various progressive improvements made in its form and use; for, like the improvements of the present day, they had in their time their advocates and their enemies: and we smile to see a grave Spaniard, Nicolas Spadoni, arguing at great length, to prove that a fowling-piece, fired with a spring lock and a flint, was preferable, in its effects and its application to use, to the matchlock, which was still practised by many at that time, and who pretended in its favour, that the fire of the match was more quick and certain than the other. If there could have been any foundation for such an opinion, what locks must those have been, when compared with the various constructions of them at the present day! That Spadoni

was right, the practice of his own days, and the improvements of succeeding times, have sufficiently proved; and we are not without hopes to see such an important and essential improvement introduced to the service of the artillery.

We can scarcely imagine that sportsmen aspired to shoot flying when the arquebuse was first applied to its use: it must have been with this invention as with all those others, the perfection of which is only developed by degrees, and according to a progression more or less slow, as circumstances will admit.

It is, therefore, easy to conceive, that mankind would, at the first, begin by shooting both the smaller and the larger game with a single ball; they would afterwards proceed to load with two or three balls, in order to cover a greater surface; they would then augment the number of these balls, decreasing their sizes in due proportion, until at length they would progressively arrive at small shot, with which they would at first be content to shoot the small game

garly call'd sitting

set *; then, by inſenſible degrees, they would be encouraged to ſhoot at objects both flying and running. Such ſeems to be the gradation which naturally preſents itſelf to the human mind. A difference in theſe practices, however, would ſtill take place in different countries, and amongſt different individuals; for at this time we find that in France there are perſons, who, when they fire, place the ſtock of the piece againſt the centre of the breaſt; that in England many good ſportſmen ſhoot with both their eyes open at the inſtant of drawing the trigger; and Pennant, in his Arctic Zoology, informs us, that the Pruſſian ſettlers in the iſle of Spitſbergen, who are moſt excellent ſportſmen, have a very peculiar method of preſenting their piece; for they do not raiſe it to the ſhoulder, but place the butt end between their arms and their ſide, fixing the eye ſteadily on the object toward which they direct the barrel.

* We here uſe the ſportſman's term; its grammatical propriety is very doubtful.

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We have been thus copious in extending our remarks upon the hint formerly thrown out, in the no leſs ſerious hopes than wiſh, that they may excite the labours of ſome individual, of more leiſure and ability than ourſelves, more and more convinced, as we are, that the enquiries and reſearches here propoſed will, in their reſults, have both their uſe and amuſement. Earneſtly, therefore, wiſhing that theſe hopes may not be diſappointed, for the preſent, it only remains for us to take leave of the public, with thanks for their candour and kind reception of the former edition of this work, and humbly recommending to their protection the following ſheets, as altered and enlarged.

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Page 231, line 3, for *with* the wind, read, *against* the wind.

AN

ESSAY

ON

SHOOTING.

PART I.

AN

ESSAY

ON

SHOOTING.

CHAP. I.

Forging of Barrels.

AS the manufacture of barrels varies considerably, we have thought it beſt to give a detail of the different methods employed; arranging them in ſuch an order as will render their deſcription as clear and conciſe as poſſible, and adding ſuch obſer-

vations as we have judged neceſſary for enabling the reader to decide upon their comparative merit.

To form a barrel in the manner generally practiſed for thoſe denominated *common*, the workmen begin by heating and hammering out a bar of iron into the form of a flat ruler, thinner at the end intended for the muzzle, and thicker at that for the breech; the length, breadth, and thickneſs of the whole plate being regulated by the intended length, diameter, and weight of the barrel. This oblong plate of metal is then, by repeated heating and hammering, turned round a cylindrical rod of tempered iron, called a *mandril*, whoſe diameter is conſiderably leſs than the intended bore of the barrel. The edges of the plate are made to overlap each other about half an inch, and are welded together by heating the tube in lengths of two or three inches at a time, and hammering it with very briſk but moderate ſtrokes, upon an anvil which has a number of ſemicircular furrows in it, adapted to the various ſizes of barrels. The heat required for welding, is the bright white heat which immediately

 precedes

precedes fuſion, and at which the particles of the metal unite and blend ſo intimately with each other, that, when properly managed, not a trace is left of their former ſeparation: this degree of heat is generally known by a number of brilliant ſparks flying off from the iron whilſt in the fire; although it requires much practice and experience to aſcertain the degree of heat required for welding iron, which poſſeſſes various qualities, and is ſeldom alike. Every time the barrel is withdrawn from the forge, the workman ſtrikes the end of it once or twice gently againſt the anvil, in a horizontal direction: this operation, which the Engliſh artiſts term *jumping*, and the French, *eſtoque*, ſerves to conſolidate the particles of the metal more perfectly, and to obliterate any appearance of a ſeam in the barrel. The *mandril* is then introduced into the bore or cavity; and the barrel being placed in one of the furrows or moulds of the anvil, is hammered very briſkly by two perſons beſides the forger, who all the time keeps turning the barrel round in the mould, ſo that every point of the heated portion may come equal-

ly under the action of the hammers.—These heatings and hammerings are repeated until the whole of the barrel has undergone the same operation, and all its parts are rendered as perfectly continuous as if it had been bored out of a solid piece. The number of heats given to each portion of two or three inches, depends chiefly upon the quality of the iron, the purer kinds uniting and consolidating much more readily and perfectly than the ordinary ones; the very best, however, require at least three welding heats.

Whilst the barrel is in the fire, the French workmen have a practice of giving, from time to time, slight horizontal strokes with the hammer to the end they hold in their left hand, so as to communicate to the heated part a vibratory motion, that serves to disengage from the pores of the metal, and throw off, such particles as are in a state of fusion, and therefore not easily convertible into malleable iron: it also separates such scales and impurities as form upon, or adhere to the surface. This operation, however, can scarcely be necessary with the first view, where the iron employed is of a pro-

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per degree of purity; as by the repeated heatings and hammerings it has, in that caſe, already undergone, theſe heterogeneous and impure particles are in a great meaſure removed, and very little left behind except the pure fibres, as it were, of the metal.

The imperfections to which a barrel is liable in forging, are of three kinds, viz. the *chink*, the *crack*, and the *flaw*. The *chink* is a ſolution of continuity, running lengthwiſe of the barrel. The *crack* is a ſolution of continuity, more irregular in its form than the *chink*, and running in a tranſverſe direction, or acroſs the barrel. The *flaw* differs from both: it is a ſmall plate or ſcale, which adheres to the barrel by a narrow baſe, from which it ſpreads out as the head of a nail does from its ſhank; and, when ſeparated, leaves a pit or hollow in the metal.

With regard to the ſoundneſs of the barrel, the *chink* and *flaw* are of much greater importance than the *crack*, as the effort of the powder is exerted upon the *circumference*, and not upon the *length* of the barrel. In a ſword, or bow, the very reverſe of this takes place; for if a *crack*, though but of a

ſlight depth, occurs in either, it will break at that place, when bent but a very little; becauſe the effort is made upon the fibres diſpoſed longitudinally; whereas if the fault be a *chink*, or even a ſlight *flaw*, the ſword or bow will not give way. The *flaw* is much more frequent than the *chink*; the latter ſcarcely ever occurring but in barrels forged as above, in which the fibres of the metal run longitudinally; and then only when the iron is of an inferior quality. When *external* and *ſuperficial*, they are all defects in point of neatneſs only; but when ſituated within the barrel, they are of material diſadvantage, by affording a lodgment to moiſture and foulneſs that corrode the iron, and thus continually enlarge the excavation until the barrel burſts, or becomes dangerous to uſe.

The barrel, when forged, is either finiſhed in the manner hereafter deſcribed, or made to undergo the operation of *twiſting*, which is a proceſs employed by the French workmen on thoſe barrels that are intended to be of a ſuperior quality and price to others; but which, as will be ſeen in the ſequel, is very

very different from that followed by the English workmen in the formation of *their* twisted barrels. This operation consists in heating the barrel in portions of a few inches at a time, to a high degree of red heat; when one end of it is screwed into a vice, and into the other is introduced a square piece of iron with a handle like an auger; and, by means of these, the fibres of the heated portion are twisted in a spiral direction, that is found to resist the effort of the powder much better than a longitudinal one. To render this operation as complete as possible, it is necessary to observe, that when once the several portions of the barrel have been twisted, the heats that are afterwards given in order to consolidate the fibres of the metal in their spiral direction, by means of the hammer, ought not to be very great; otherwise the grain of the metal will regain its former state, and the barrel be no better than it was before it underwent the twisting.

From the process it is evident, that to twist a barrel in this manner, throughout its whole length, it must be forged near a foot and half

longer than it is intended to be when finiſhed, that a portion at each end may be kept cold, ſo as to give a ſufficient purchaſe to the vice and twiſting inſtrument during the operation: theſe portions are afterwards to be cut off before the barrel is bored. Or, to ſave the time and labour this would neceſſarily take up, two pieces of an old barrel may be welded to the muzzle and breech of that which is to be twiſted, and cut off after the operation is finiſhed: theſe pieces may alſo be made ſtronger than uſual, the better to ſuſtain the force of the vice and twiſting inſtrument; and, in order to give the latter a better hold, the muzzle piece may have its cavity made of a ſquare form. From not following one or other of theſe methods, the greater number of the French barrels *ſaid* to be *twiſted,* are only ſo in part, there being at leaſt ſix inches at the muzzle, and ſeven or eight at the breech, which are not affected by the operation. The Engliſh workmen with whom we have converſed upon this ſubject, are all of opinion, and ſeemingly with reaſon, that this proceſs of twiſting,

ing, as performed by the French workmen, is really injurious to the barrel, by ſtraining the fibres of the metal.

To perſons unacquainted with the loſs which iron ſuffers in forging, it will be a matter of ſurpriſe that twelve pounds of iron are required to produce a barrel, which, when finiſhed, ſhall not weigh more than two pounds, or two pounds and a half. But although a conſiderable waſte is unavoidable, yet the quantity of it depends very much upon the quality of the iron, upon that of the coal, and upon the knowledge and dexterity of the workman. By much the greater part is conſumed in the fire; and the waſte here may ariſe either from the iron being impure, from its being kept too long in the fire, or from the coal imparting ſulphur to it, and making it run*: a conſiderable por-

* In Spain they cannot work but with charcoal of wood; in France they employ pit-coal charred, or *coaks;* in England they uſe pit-coal without being charred, but are very careful to have it of the pureſt kind, ſome ſorts containing a portion of ſulphur and arſenic which render the metal altogether unmalleable, or, in the language of the workmen, *poiſon* the iron.

tion

tion is alſo driven off in the form of ſcales by the hammer, eſpecially when the iron is hammered at a low red heat: the remainder is taken away in the after operations of boring and filing the barrel. Muſquet barrels, and thoſe for ordinary fowling pieces, are all forged of Swediſh iron; that which comes from Ruſſia being too coarſe and untractable to be wrought into barrels of any kind.

A circumſtance of conſiderable importance to the excellence of a barrel, is, the forging it as near as can be to the weight it is intended to be of when finiſhed, ſo that very little be taken away in the boring and filing; for as the outer ſurface, by having undergone the action of the hammer more immediately than any other part, is rendered the moſt compact and pure, we ſhould be careful to remove as little of it as poſſible: the ſame thing holds, though in a leſs degree, with regard to that portion of the inſide of the barrel which is to be cut out by the boring inſtrument.

Piſtol barrels are forged in one piece, and

are

are cut aſunder at the muzzles after they have been bored; by which there is not only a ſaving of iron and of labour, but a certainty of the caliber being perfectly the ſame in both.

CHAP.

CHAP. II.

Boring and Dreſſing of Barrels.

THE next operation conſiſts in giving to the barrel its proper caliber: this is termed *boring*, and is performed by means of the following machine.

Two beams of oak, each ſix or ſeven feet long, and about ſix inches ſquare, are placed horizontally and parallel to each other, by having each of their extremities mortiſed upon an upright piece, which is of equal ſtrength, about three feet high, and firmly fixed. Between the horizontal pieces there intervenes a ſpace of three or four inches, in which a piece of wood is made to ſlide, by having at either end a tenon that is let into a groove which runs on the inſide of each beam its whole length. Through this ſliding piece there is driven, or rather ſcrewed, in a perpendicular direction, a ſtrong pin

pin or bolt of iron, having at its upper end a round hole or eye large enough to admit the breech end of the barrel, which is secured in it by means of a piece of iron that ſerves as a wedge, and a vertical ſcrew that paſſes through the upper part of the eye, or hole. To a ſtaple in one ſide of the ſliding piece, there is faſtened a chain, which runs between the two horizontal beams, and paſſing over a pully at one end of the machine, has a weight which may be hooked on to it at pleaſure. Immediately above this pully, and between the ends of the beams, there is fixed an upright piece of timber, whoſe upper end is perforated by the axis of an iron crank that is furniſhed with a ſquare ſocket; the other axis being ſupported by the wall, or by a ſtrong poſt, and loaded with a heavy wheel of caſt iron, to give it force: the axes of this crank are in a line with the eye of the bolt already mentioned. The borer being fixed into the ſocket of the crank, has its other end, which is previouſly well oiled, introduced into the barrel, whoſe breech part is made faſt in the eye of the bolt; the chain is then carried over the pully, and

and the weight hooked on; when, the crank being turned by the hand, the barrel advances as the *borer* cuts its way, until the instrument has passed through its whole length.

The boring *bit* is a rod of iron, somewhat longer than the barrel; one end being made to fit the socket of the crank, and the other being furnished with a cylindrical plug of tempered steel, about an inch and a half in length, and having its surface cut in the manner of a perpetual screw, the threads (which are five or six in number) being flat, about a quarter of an inch in breadth, and running with very little obliquity. The furrows are of the same breadth as the threads, and of a sufficient depth to let the metal cut out by the latter, pass through them easily, so as to keep the instrument free. This form gives the bit a very strong hold of the metal; and the threads being sharp at the edges, scoop out and remove every roughness and inequality from the inside of the barrel, and render the cavity smooth and equal throughout. A number of bits, each a little larger than the preceding one, are afterwards successively

ceſſively paſſed through the barrel in the ſame way, until it has acquired the intended caliber.

The borer heats the barrel very much, eſpecially the firſt time it is paſſed through; and generally warps it more or leſs. To prevent this in ſome meaſure, the barrel is covered with a cloth, which, by being kept conſtantly wetted, hinders the barrel from becoming too warm, and alſo preſerves the temper of the boring bit. The borer is likewiſe withdrawn from time to time, to clear away the ſhavings of the metal, to oil the *bit* afreſh, and to repair any damage it may have ſuſtained during the operation. The barrel is carefully examined every time a freſh *bit* has been paſſed through, to ſee if it be in the leaſt warped by the boring; and alſo to diſcover if there are any ſpots, called by the workmen *blacks*, on its inſide. If it be caſt, or warped, it is carried to the anvil, where, by a few ſlight ſtrokes of the hammer upon the convex parts, it is brought perfectly ſtraight again; this is termed *ſetting up* the barrel. If, when the barrel is nearly arrived at the intended caliber, any dark ſpots are perceived

upon

upon its inſide by looking through it when held up to the light, the part is marked upon the outſide; and, by ſtriking it gently with the hammer, is driven in ſo as to be completely removed by repaſſing the boring inſtrument.

To aſcertain the equality of the bore, a cylindrical plug of tempered ſteel about an inch long, highly poliſhed, and fitting the bore exactly, is ſcrewed upon the end of an iron rod, and introduced into the cavity of the barrel, where it is moved backwards and forwards; and the places being marked where it paſſes with any difficulty, the boring bit is repeatedly paſſed until the plug moves through every part with equal eaſe.

The equality of the bore is ſo eſſential to the excellence of a piece, that the greateſt accuracy in every other particular will not compenſate for the want of it. Any perſon who wiſhes to know the merit of his piece in this reſpect, may do it with tolerable accuracy, by means of a plug of lead, caſt on a rod of iron or wood; or even by a muſquet ball filed ſo as to fit the bore exactly, and puſhed through the barrel by the ramrod,

rod, care being taken not to ufe an iron ram-rod, or much force, left the ball be flattened, and an artificial difficulty created.

It now remains to fmooth the infide of the barrel, and remove the marks left by the boring inftrument. This operation is termed *fine boring*. The inftrument with which it is performed, refembles in its general form the boring bits already defcribed; the cutting portion of this, however, is a fquare broach, ten or twelve inches in length, highly polifhed, and very fharp, whereby it cuts the metal very fmoothly. As it is found to cut more fmoothly and equally when only two of its edges are allowed to work, the other two are covered by flips of paper, well oiled, being laid along one of its fides; one or more additional flips being put on every time the inftrument is paffed through the barrel. This inftrument is repeatedly paffed through the barrel, from breech to muzzle, and from muzzle to breech, until the infide prefents to the eye a perfectly equal and polifhed furface: the barrel is alfo examined at each time, and, if neceffary, *fet up* in the manner already defcribed. It is very effen-

tial to the perfection of the *fine boring*, that the instrument employed be forged perfectly true, and that it has not been cast or warped in the tempering.

The barrel may now be considered as quite finished with regard to its inside; at least it has nothing more done to it by the *maker*. The *gunsmiths*, however, generally make it undergo a farther operation of polishing, the good effects of which are very doubtful, as will be evident from the manner in which it is performed. Upon a rod of iron somewhat longer than the barrel, they cast a cylinder of lead five or six inches long, which they file so as to fit the bore exactly: this is then covered with very fine emery and oil; and being introduced into the barrel, is wrought backwards and forwards through its whole length, until the cavity has acquired a high degree of polish. Now it is scarcely possible for this instrument to be wrought by the hand, in such a steady and equal manner as not to press more upon some parts of the barrel than upon others. Besides, the exquisite polish which is produced by this operation, lasts but for a short time;

time; and the polish it received from the hands of the maker seems fully sufficient for every useful purpose.

The barrel is now in a condition to receive its proper form and proportions externally, by means of the file. To do this with accuracy, four flat sides or faces are first formed; then eight, then sixteen; and so on, until it is made quite round; except the reinforced part, which, in most of the modern work, is left with eight sides*. In this, however, different gunsmiths exercise their own fancy and taste, both with respect to the number of sides and the length of the reinforced part.

It is absolutely necessary to the soundness of a barrel, that it should be of an equal thickness on every side; or, in the language of the workmen, *a barrel ought to be perfectly upright.* In order to arrive as nearly as pos-

* This octagonal form of the reinforced part, is certainly more elegant than the round one formerly in use. But it adds to the weight of the barrel, without increasing its strength; for the effort of the powder will be always sustained by the thinnest part of the circumference, without any regard to those places that are thicker than the rest.

ſible to this perfect equality, the gunſmiths employ an inſtrument which they call a *compaſs*. It conſiſts of an iron rod bent ſo as to form two parallel branches about an inch diſtant from each other. One of theſe branches is introduced into the barrel, and kept cloſely applied to the ſide by means of one or more ſprings with which it is furniſhed: the other branch deſcends parallel to this, on the outſide, and has ſeveral ſcrews paſſing through it with their points directed to the barrel. By ſcrewing theſe until their points touch the ſurface of the barrel, and then turning the inſtrument round within the bore, it is ſeen where the metal is too thick, and how much it muſt be reduced in order to render every part of the barrel perfectly equal throughout its circumference. This inſtrument may be made ſufficiently long to reach the whole length of the barrel; but it will be more convenient, as well as more exact, to have it little more than half the length; and to introduce it firſt at one end, and afterwards at the other, of the barrel.

The compaſs, however, is an inſtrument ſo extremely imperfect in its own nature,

that

that it requires very delicate management, even when of the beſt conſtruction, to ſhew the equality of the barrel to any degree of accuracy.—The gunſmiths have all of them compaſſes of different conſtructions, each of whom fails not to praiſe his own as the beſt. But that invented by *Manton* is the beſt of the kind which we have ſeen.

Some perſons, inſtead of dreſſing the outſide by means of the file and compaſs, do it, at leaſt the round part, by turning in a lathe. This method is without doubt more expeditious than that juſt deſcribed; but it is by no means certain that it is equally ſafe, or even equally exact. It is impoſſible to prevent a ſpindle that is the length of a gun barrel, from ſpringing conſiderably under the tool employed to reduce or ſmooth the barrel in turning; and, accordingly, it is found that barrels are often more warped in the turning, than in any of the borings they have undergone; and that, from their greater thinneſs at this time, they cannot be *ſet up* as before without danger of ruining them entirely.

When the barrel is completely dreſſed and

ſmoothed on the outſide, the French workmen proceed to ſolder on the loops and aim, before they breech the barrel; for, as they uſe *hard* ſolder, the degree of heat neceſſary in the operation, produces a roughneſs on the inſide of the barrel oppoſite to the places where they are fixed; and this is ſometimes ſo conſiderable as to require the *fine boring* inſtrument to be again paſſed through the barrel, which could not be done after the ſcrew is formed for the breech, without injuring the threads. The Engliſh workmen, however, faſten on the loops, &c. with *ſoft* ſolder, which is found quite ſufficient for the purpoſe; and as the heat required for this does not affect the inſide of the barrel, they have the choice of doing it either before or after the breeching, as is moſt convenient to themſelves.

To form the ſcrew in the breech end of the barrel, the firſt tool employed is a plug of tempered ſteel, ſomewhat conical, and having upon its ſurface the threads of a male ſcrew. This tool, which is termed a *ſcrew tap*, being introduced into the barrel, is turned from left to right, and back again, until

until it has marked out the three or four firſt threads of the ſcrew: another leſs conical *tap* is then introduced; and when this has carried on the impreſſion of the ſcrew as far as it is intended to go, a third *tap* is employed, which is nearly cylindrical, and ſcarcely differs from the plug of the breech which is intended to fill the ſcrew thus formed in the barrel.

The breech *plug* has its ſcrew formed by means of a *ſcrew plate*, made of tempered ſteel, and has ſeveral *female* ſcrews correſponding with the *taps* employed to form that in the barrel. A plug of ſeven or eight threads is ſufficiently long; and the threads ought to be neat and ſharp, ſo as to fill completely the turns made in the barrel by the *tap*. The breech plug is afterwards *caſe-hardened*, or has its ſurface converted into ſteel, by being covered over with ſhavings of horn, or parings of horſe hoof, and kept red-hot in the fire for ſome time, after which it is plunged into water.

The laſt operation is that of colouring the barrel, previous to which it is poliſhed with fine emery and oil, until it preſents to the

eye, throughout its whole length, and in whatever direction we obſerve it, a perfectly ſmooth, equal, and ſplendid ſurface. Formerly, barrels were coloured by expoſing them to a degree of heat which produced an elegant blue tinge; but as this effect ariſes from a degree of calcination taking place upon the ſurface of the metal, the *inſide* of the barrel always ſuffered by undergoing the ſame change. This, therefore, added to the painful ſenſation excited in the eye by looking along a barrel ſo coloured, has cauſed the practice of *blueing* to be diſuſed for ſome time paſt. Inſtead of it, barrels are now *browned*, as it is termed. To do this, the barrel is rubbed over with *aqua fortis* or *ſpirit of ſalt*, diluted with water, and laid by until a complete coat of ruſt is formed upon it; a little oil is then applied; and the ſurface being rubbed dry, is poliſhed by means of a hard bruſh, and bees wax.

When the barrels intended for a double-barrelled piece are dreſſed to their proper thickneſs, which is generally leſs than for ſingle barrels, each of them is filed flat on the ſide where it is to join the other, ſo that

they

they may fit clofely together. Two correfponding notches are then made at the muzzle and breech of each barrel; and into thefe are fitted two fmall pieces of iron, to hold them more ftrongly together. The barrels being united by tinning the parts where they touch, the *ribs* are fitted in, and made faft by the fame means. Thefe ribs are the triangular pieces of iron which are placed between the barrels, running on the upper and under fides their whole length, and ferving to hold them more firmly together. The under rib is a late improvement, and is found more effectually to prevent the barrels from warping. When the barrels are thus joined, they are polifhed and coloured in the manner already defcribed.

Great care fhould be taken that the barrels intended to be joined in this way, be perfectly *upright*, and that both be of the fame thicknefs and ftrength; for, if but a very trifling inequality in this refpect takes place, the weaker barrel will yield to the ftronger: the warping from this caufe has been fometimes fo confiderable, as to render one of the barrels altogether ufelefs. To bring

bring every part of the circumference of each barrel as nearly as poſſible to an equal ſtrength, ſo that the force of the exploſion may not ſtrain one part more than another; that ſide where the barrels touch each other, muſt be ſo reduced, that the partition between the two calibers be no thicker than either barrel was at the ſame place before it was filed to join in this manner.

Formerly, the double-barrelled pieces were made with one barrel lying over the other, each barrel having a ſeparate pan, hammer, and hammer-ſpring; but there was only one cock for both. The barrels were therefore made to turn round at the place where their breeches joined with the ſtock; ſo that, as ſoon as one was fired off, the other could be brought into its place, by preſſing with the right hand a ſpring moved by the guard, whilſt with the left the barrels were turned upon their common axis: as ſoon as the charged barrel was thus brought into its proper ſituation, the ſpring deſcended into a notch, and kept it firm. From the deſcription, it is evident, that all the work

giving

giving motion to the cock, muſt be confined to the part behind that at which the barrels turn round, and, from its being thus crowded, muſt of courſe be more difficult to conſtruct; and the time taken up in thus turning the barrel round, almoſt renders the ſecond barrel uſeleſs.

In the ſame way, three, and even four barrels, have been mounted upon one ſtock; but as theſe pieces are intolerably heavy, and do not, any more than thoſe juſt deſcribed, poſſeſs any real advantage over the double-barrelled pieces that do not turn round, we ſhall forbear entering into any further deſcription of them.

But a better mode was afterwards invented for double-barrelled pieces of this deſcription: the barrels did not turn round upon an axis, they were fixed one over the other; and each had a ſeparate lock and trigger, that for the under barrel being conſequently placed lower than the other. Still, although pieces of this conſtruction poſſeſs a great advantage over thoſe that turn round, in the quickneſs of their firing; yet they are

are ſubject to one inconvenience from which the others are exempt, and which takes place in the under barrel; for that being fired under the ſame line of aim with the upper one, muſt neceſſarily ſhoot low.

CHAP. III.

Improvements in the Manufacture of Barrels.

HAVING defcribed, we hope with fufficient clearnefs, the feveral proceffes gone through in the manufacture of ordinary barrels, and the methods of finifhing, which are equally adapted to every fort; we now proceed to give an account of a great variety of *real*, as well as *fancied* improvements, that have been fuggefted and practifed at different times; beginning with the *twifted* barrels, as made by the Englifh workmen.

Thefe barrels are defervedly celebrated for their fuperior elegance and ftrength, as well as for the accuracy with which they throw either ball or fhot. The iron employed in them is formed of *ftubs*, which are old

horſe-ſhoe nails, procured from country farriers, and from poor people who gain a ſubſiſtence by picking them up on the great roads leading to the metropolis. These are originally formed from the ſofteſt and tougheſt iron that can be had; and this is ſtill farther purified by the numerous heatings and hammerings it has undergone in being reduced from a bar into the ſize and form of nails. They coſt about ten ſhillings the hundred weight, and twenty-eight pounds are required to make a ſingle barrel of the ordinary ſize. A hoop of iron about an inch broad, and ſix or ſeven inches diameter, is placed perpendicularly; and the *ſtubs*, previouſly freed from dirt by waſhing, are neatly piled in it, with their heads outermoſt on each ſide, until the hoop is quite filled and wedged tight with them; the whole reſembling a rough, circular, cake of iron. This is put into the fire until it has acquired a white heat; when it is hammered either by the ſtrength of the arm, or by the force of machinery, until it coaleſces, and becomes one ſolid maſs of iron: the hoop is then removed, and the heatings and hammerings repeated

repeated until the iron, by being thus wrought and kneaded, is freed from every impurity, and rendered very tough, and cloſe in the grain; the workman then proceeds to draw it out into pieces of about twenty-four inches in length, half an inch or more in breadth, and half an inch in thickneſs.

Theſe pieces, however, are not all of the ſame *thickneſs*; ſome being more and others leſs than what we have mentioned, according to the propoſed thickneſs of the barrel, and that part of it which the piece is intended to form. One of theſe pieces being heated red-hot for five or ſix inches, is turned like a cork-ſcrew, without any other tools than the anvil and hammer. The remaining portions are ſucceſſively treated in the ſame manner; until the whole piece is turned into a ſpiral, forming a tube whoſe diameter correſponds with that of the intended barrel. Four of theſe are generally ſufficient to form a barrel of the ordinary length, which is from 32 to 38 inches; and the two which form the breech, or reinforced part, are conſiderably thicker than thoſe which conſtitute the fore part, or muzzle of

the barrel. The workman firſt welds one of theſe tubes to a part of an old barrel, which ſerves as a handle. He then proceeds to unite the turns of the ſpiral to each other, by heating the tube two or three inches at a time, to a bright white heat, and ſtriking the end of it ſeveral times againſt the anvil, in a horizontal direction, and with conſiderable force: this is termed *jumping* the barrel; and the heats given for the purpoſe, are called *jumping heats*. A mandril is then introduced into the cavity; and the heated portion is hammered lightly, to flatten the ridges or burrs raiſed by the jumping at the place where the ſpirals are joined. As ſoon as one piece is *jumped* its whole length, another is welded to it, and treated in the ſame manner, until the four pieces are united; when the part of the old barrel, being no longer neceſſary, is cut off. The welding the turns of the ſpiral is performed exactly in the ſame manner as deſcribed (p. 3 and 4) for plain barrels, and is repeated *three* times. The barrel is afterwards finiſhed in the ſame way as a common one. Stub iron is alſo wrought into plain barrels, which,

as

as they require a great deal lefs labour, are only half the price of the *twifted* ones.

The *Canons à ruban*, or *ribbon barrels*, of the French, very much refemble the Englifh twifted barrels. The procefs purfued in their formation is confiderably more operofe than that juft defcribed, but feems to be far from poffeffing any advantage over it, as will be evident from a defcription of the former, which we here fubjoin. A plate of iron, about the twelfth part of an inch in thicknefs, is turned round a mandril, and welded its whole length, in the fame manner as a plain barrel. Upon this fmall and light barrel, which is called the *lining*, a ftripe or plate of iron, about an inch in breadth, and bevelled off at the edges, is rolled in a fpiral direction, by means of fucceffive heats: this fpiral is termed the *ribbon*, and its thicknefs muft correfpond with the part of the barrel it is to conftitute. As a ribbon of fufficient length to cover the lining from one end to the other would be very difficult to manage, it is formed in feveral pieces; and as foon as

one piece is nearly rolled on, another is welded to the end of it, and the operation continued until the whole of the lining is covered. The edges are bevelled ſo much, that one edge overlaps the other about a quarter of an inch. When the *ribbon* is all rolled on, the barrel is heated by two or three inches at a time, and the turns of the ſpiral united to each other and to the lining, by being welded in the ſame manner as a twiſted or a plain barrel *, but requiring more care and accuracy in the operation. It is afterwards bored ſo that almoſt the whole of the lining is cut out, and ſcarcely any thing left except the ribbon with which it was covered.

The acknowledged ſuperiority of twiſted and ribbon barrels over plain ones, has induced ſome perſons to counterfeit them, by colouring plain barrels ſo as to ſhew a ſpiral line running from one end to the other. This is done by winding a thread

* From the conſtruction of *ribbon barrels*, it is evident that the operation of *jumping* is not admiſſible in them.

or

or ſtring in a ſpiral direction round a plain barrel, and then wetting the ſtring with the diluted aqua fortis, or ſpirit of ſalt, ſo that a coat of ruſt may be formed where the ſtring touches: when the acid is applied a ſecond time over the whole barrel, the part over which the ſtring was applied, by being more ruſted than the reſt, ſhews a dark line winding round the barrel, and renders it, when finiſhed, ſcarcely diſtinguiſhable from a twiſted or ribbon barrel. Other barrels are, by the ſame means, clouded in an irregular manner, ſo as to reſemble thoſe formed of *ſtub* iron. To prove whether or not a barrel is really what it appears to be, we need only fix upon any part on the under ſide, that is covered by the ſtock, and having cleared it, if neceſſary, with a fine file, apply a feather dipped in aqua fortis, which in a little time will render the fibres of the metal diſtinctly viſible, in whatever direction they run. In examining the *French twiſted* barrels, however, we muſt not make the trial near either the breech or the muzzle, as we have already obſerved, that theſe barrels are

ſeldom twiſted throughout their whole length.

An ingenious workman called Barrois, formerly eſtabliſhed at Paris, and but lately dead, having conſidered the eſtimation in which *ribbon* barrels were held, invented a new ſort, which he called *wired* barrels. His method was this. Upon a thin barrel, forged, filed, and dreſſed as uſual, he rolled, in a ſpiral direction, and as cloſely as poſſible, a tempered iron wire, about the thickneſs of a crow quill; the firſt layer covering only the fortified or reinforced part. The turns of the wire were ſoldered to each other, and to the barrel, with a particular compoſition which he kept a ſecret. He then filed the wired part ſo as to render it ſmooth and bright, but not ſo much as to weaken it; and applied a ſecond layer of wire, which covered the firſt, and extended two-thirds of the length of the barrel: the ſecond layer being ſoldered and brightened like the firſt, he added a third that covered the two firſt, and reached quite to the muzzle.

This proceſs of the Sieur Barrois is in-

ingenious; and Monf. de Marolles fays, that one of thefe barrels which was forced in the proof, warped and fwelled out without burfting. But, however plaufible the contrivance may be, it is certain that thefe barrels are liable to imperfections from which the greateft addrefs and care of the workmen cannot entirely free them. Wire is drawn from the bar without heat, and it is not improved in the fmalleft degree by the operation; thefe barrels have, therefore, no claim to preference on account of the quality of the metal, which is really no better than that of which the ordinary barrels are made.

No metal has yet been found equal to iron, for making gun barrels; and as the fpace occupied by the folder in the barrels of the Sieur Barrois is nearly equal to that taken up by the wire, the ftrength of the barrel is confiderably lefs than if the whole had been formed of iron only. Independent of the defects that may occur in the wire itfelf, there will always be little cavities between its turns, which will not

be completely filled by the folder. Befides, as this *wiring* was performed by the Sieur Barrois upon a barrel that had been previoufly bored and dreffed within, the repeated confiderable heats it was neceffarily expofed to in the foldering, if they did not warp it, at leaft rendered it fo rough on the infide, that it required to be fine-bored afterwards. The only fuperiority, therefore, which they could be faid to poffefs, was, their beautiful appearance when finifhed; and this was greatly overbalanced by the circumftances mentioned, and by the extravagance of their price, a fingle barrel amounting to 120 French livres, or 5l. fterling, and a double barrel to twice that fum. Their fale, however, by no means anfwered his expectations, and fince his death no other perfon has thought of making them. With regard to the treble proof to which the Sieur Barrois pledged himfelf in his Profpectus, publifhed in 1771, to fubmit his barrels, it is never refufed by the gunfmiths of any country, provided the barrels be of a fuitable thicknefs; and thofe

thoſe of Barrois were even thicker than ordinary.

The Spaniſh barrels have always been held in great eſteem, as well on account of the quality of the iron, which is generally conſidered as the beſt in Europe, as becauſe they poſſeſs the reputation of being forged and bored more perfectly than any others. It ſhould be obſerved, however, that, of the Spaniſh barrels, thoſe only that are made in the capital are accounted truly valuable; in conſequence of which a great many have been made at other places, eſpecially in Catalonia and Biſcay, with the names and marks of the Madrid gunſmiths: they are alſo counterfeited at Liege, Prague, Munich, &c. and a perſon muſt be a very good judge not to be deceived by theſe ſpurious barrels.

Notwithſtanding there have always been excellent gunſmiths at Madrid, yet the barrels which bear the higheſt price, and are the moſt ſought after by the curious in this way, are thoſe made by artiſts who have been dead for many years; though

perhaps this preference has no better foundation than the common prejudice in favour of things that are the productions of remote ages or distant countries: *Major e longinquo reverentia.* Such are the barrels of *Nicolas Biz*, who was famous at Madrid in the beginning of this century, and died in 1724: those he made in the former part of his life are the most esteemed. The barrels of *Juan Belen*, and *Juan Fernandez*, cotemporaries of *Nicolas Biz*, are not less prized; and in France all of them sell for 1000 livres, or 43l. 15s. sterling. Those of *Diego Esquibel*, *Alonzo Martinez*, *Gabriel Agora*, *Agostin Ortiz*, *Mathias Vaëra*, *Luis Santos*, *Juan Santos*, *Francisco Garcia*, *Francisco Targarone*, *Joseph Cano*, and *N. Zelaya*, all of them celebrated workmen, who succeeded those already mentioned, in the order of their names, are also in great request.

Of the artists now or lately living at Madrid, the most celebrated are, *Francisco Lopes*, *Salvador Cenarro*, and *Miguel Zeguarra*, gunsmiths to the king: *Isidoro Soler*, and

and *Juan de Soto*, have alſo great reputation. The barrels of thoſe living workmen ſell for 300 French livres, or ſomewhat more than 13l. ſterling, which is the price paid for thoſe made for the king and royal family. They are proved with a treble charge of the beſt powder, and a quadruple one of ſwan or deer ſhot. At Madrid, and throughout all Spain, the manufacture of barrels is not, as in this and moſt other countries, a ſeparate branch of the gun-making buſineſs; but the ſame workman makes and finiſhes every part of the piece.

After the barrels of Madrid, thoſe of *Buſtindui* and *St. Olabe* at Placentia in Biſcay; and of *Jean* and *Clement Pedroeſteva*, *Eudal Pous*, and *Martin Maréchal*, at Barcelona, are the moſt eſteemed; theſe uſually ſell in France for 80 French livres, or 3l. 10s. ſterling.

Almoſt all the barrels made at Madrid are compoſed of the old ſhoes of horſes and mules, collected for the purpoſe. They are all welded longitudinally; but inſtead of

of being forged in one plate or piece, as in other countries, they are made, like the English twisted barrels, in five or six detached portions, which are afterwards welded one to the end of another, two of them forming the breech, or reinforced part of the barrel. We may form some idea of the very great purity to which the iron is brought in the course of the operation, when we are told, that to make a barrel, which, rough from the forge, weighs only six or seven pounds, they employ a mass of mule-shoe iron weighing from forty to forty-five pounds; so that from thirty-four to thirty-eight pounds are lost in the heatings and hammerings it is made to undergo before it is forged into a barrel.

The advantages which the Spanish workmen allege to result from this method of forging the barrel in several pieces, are,

First,—That the iron, by being forged in smaller portions, is the better wrought and purified.

Secondly,—That should a defect be discovered in any one of the pieces after being

ing turned into a cylinder and welded, they can reject that one, and ſubſtitute another.

Thirdly,—That by proportioning the thickneſs of each piece to the part of the barrel it is intended to occupy, very little is left for the file to do.

The *firſt* of theſe advantages is very trifling; for the diviſion is not, as in the caſe of *ſtubs*, ſo minute as to expoſe to the action of the fire and the force of the hammer, a ſurface conſiderably greater than if the barrel had been forged in a ſingle piece. The *ſecond* is not confined to barrels forged in ſeparate pieces; for if a defect be obſerved at any part of a barrel that is forged in a ſingle piece, the part can be cut out, and the ends of the ſound pieces joined, or a new piece welded between them. With regard to the *third*, it may, perhaps, be uſeful to forge the reinforced part in *one* piece, and the reſt of the barrel in another; but it certainly cannot be neceſſary for the ſame reaſon to forge it in five or ſix pieces.

This

This, however, is not the only thing in which the Spaniſh workmen differ from thoſe of other countries. Inſtead of making the plate overlap a *little* where it is joined, they give it another complete turn, ſo that every Spaniſh barrel may be ſaid to be double throughout. The different portions are alſo forged, ſo that the grain of the iron, inſtead of being longitudinal, is diſpoſed circularly, and follows the round of the barrel in ſuch a manner as to give the effect of a *ribbon* or *twiſted* barrel. They do not regulate the thickneſs of the barrel by means of the *compaſs*, but in its room employ round rulers to conduct the file; and finiſh the outſide by turning in a lathe: perhaps it is owing to this cauſe that the Spaniſh barrels never are ſo well finiſhed on the outſide as thoſe of the Engliſh and French.

Alonzo Martinez de Eſpinar, arquebuſs bearer to Philip IV. in a treatiſe which he wrote upon this ſubject, informs us, that *Juan Sanchez de Mirvena*, gunſmith to Philip III. and the ableſt artiſt of his time,

time, was the firſt who forged barrels in ſeparate pieces, as well as the inventor of ſeveral inſtruments for dreſſing and finiſhing them with greater accuracy. Speaking of the barrels of this artiſt, he ſays, "*hizieronſe grandes pruevas en ellos, y fueron* "*conocidos por los mejores*;" they ſuſtained extraordinary proofs, and were acknowledged ſuperior to all others. He does not, however, inform us what theſe extraordinary proofs were; but ſays of the Madrid barrels in general, that in his time they were proved, after being finiſhed within, and before they were filed, with a charge of powder equal to the weight of the ball which fitted their caliber, and four times this weight of large ſhot; and, that this proof was repeated three times.

The Spaniſh barrels are generally from three to three and a half feet long; their caliber from 22 to 24*, and their weight

* In ſpeaking of the ſize of the caliber, we mean by 22 or 24, that ſo many balls exactly fitting it weigh juſt one pound; and every caliber is marked in the ſame way.

from

from three to three and a half pounds. The reinforced part extends two-fifths the length of the barrel. At ten or twelve inches from the breech is placed a *ſight*, ſuch as is uſually put upon rifle barrels, or upon thoſe intended to ſhoot ball only, and the muzzles are in general a little bell-mouthed. Formerly the Spaniſh barrels were made much heavier than at preſent; and they ought, according to Eſpinar, to weigh at leaſt four pounds and a half, if forty inches long, and of the caliber we have mentioned. For ſome years paſt, however, they have made them much ſhorter than this, and they now rarely exceed three feet.

The Spaniſh gunſmiths pique themſelves upon the very high poliſh they give to the inſide of their barrels. We have already expreſſed our doubts about the advantage derived from this, and are ſtill of opinion, that if a barrel is ſo ſmooth as not to *lead* *,

* A barrel is ſaid to *lead*, when it is ſo rough within, that, after firing, the places where the ball or ſhot rubbed in their paſſage can be perceived, by part of the lead being left upon them.

it

it is better to take it as it comes from the hand of the manufacturer, than allow the gunſmith to practiſe any farther operation upon it: in ſupport of this opinion, Monſ. de Marolles informs us, that he has ſeen a barrel rough from the borer, throw a charge of ſhot deeper into a quire of paper, than another barrel that was highly poliſhed within, although the length, the bore, and the charge were the ſame in both.

Notwithſtanding the great reputation of the Spaniſh barrels, however, they are little uſed in France, and ſtill leſs in England; their awkward form, and their great length and weight, being ſtrong objections to them, eſpecially ſince they have begun to make their pieces ſo very ſhort and light in theſe countries. And from our own experience of the Spaniſh barrels, we are convinced, that the avidity with which they are ſought after by ſome perſons, and the extravagant prices that are given for them, proceed more from a *fancied*, than from any *real* ſuperiority they poſſeſs over thoſe made in this country.

As the Spaniſh iron, and eſpecially that of Biſcay, is acknowledged to be of a very ſuperior quality, and as there is every reaſon to believe that the reputation of the Spaniſh barrels is more owing to this than to any ſuperior excellence of the workmen; Monſ. de Marolles informs us that they have tried to work it at Paris, but that hitherto the French workmen have not diſcovered the preciſe degree of heat it requires, which is, no doubt, different from that found to ſuit the French iron. This, he ſays, he has learned from the workmen themſelves; but he at the ſame time obſerves, that this difficulty is very probably owing to their uſing pit-coal, or coaks, whilſt the Spaniſh workmen employ only the charcoal of wood; and that, to weld the Spaniſh iron, a much more moderate heat is required than what is afforded by pit-coal, and, perhaps, conducted alſo in a manner unknown in France. He adds, moreover, that, as workmen are obſtinately attached to the methods they have been long in the habit of practiſing, it is not

to be wondered at if they ſhould miſcarry in their firſt trials of any new ſcheme; but that an expert and intelligent workman, who took the neceſſary pains, would no doubt ſucceed where others had failed, and this either by employing the charcoal of wood, or ſtudying the proper management of the fire where *coaks* are uſed. In confirmation of this, we know that Spaniſh iron has been wrought in England, without any of the difficulties which the French workmen are ſaid to have met with, notwithſtanding that *crude* pit-coal alone is employed here.

The Spaniſh iron, owing either to its ſcarcity or high price, is not much employed in this country. During the late war, ſome gunſmiths procured it in tolerable quantity, by purchaſing from the agents of Spaniſh prizes the barrel hoops, which, either from the cheapneſs of iron *in Spain*, or the want of flatting mills, &c. are unneceſſarily thick and clumſy: this iron had alſo the advantage of being better wrought, and purified by the repeated heatings and

 hammer-

hammerings required to form it into hoops.

The barrels of *Lazaro Cominazzo*, called after the maker, *Lazarini*, were formerly celebrated throughout the greateſt part of Europe. They were very long, and of a very ſmall caliber. Cominazzo lived at Breſcia, about a hundred and fifty years ago. He did not forge theſe barrels himſelf, but he finiſhed them with great accuracy, and ornamented them in a very rich and elegant manner. At the time, however, when theſe barrels were in high eſtimation, there were numerous counterfeits bearing the name and mark of Cominazzo; and it requires ſome acquaintance with the genuine barrels not to be deceived by the ſpurious ones. The true *Lazarini* are now to be found only in the repoſitories of the curious.

The vanity of poſſeſſing ſomething that is ſingularly curious, the falſe idea that whatever is expenſive muſt neceſſarily be good, and ſometimes, though rarely, the laudable deſire of improvement, have all in their turns been the cauſes of a variety of

ex-

experiments being made in the manufacture of barrels. An artiſt * of this city, whoſe ſuperior excellence in this branch deſerves to be known to every ſportſman, for many reaſons that might be pointed out, informs us, that he has wrought a great deal of Spaniſh iron; that he has forged barrels from old ſcythes, from wire, from needles, and a great many other articles ſuggeſted by the whim of his cuſtomers; he has alſo made barrels with a lining of ſteel, and formed others with a double ſpiral of ſteel and iron alternately; but that, as far as he can determine from theſe numerous trials, the ſtub iron wrought into a twiſted barrel is ſuperior to every other. Wherever ſteel was employed, he found that the barrel neither welded nor bored ſo perfectly as when iron alone was uſed.

* Mr. Fuller, of St. John-Street, Clerkenwell.

CHAP. IV.

Proofs of Barrels.

THESE differ in different countries. The Spanish proof, which has already been mentioned, is a very severe one; but as it is made before the barrel is filed and dressed on the outside, it is not satisfactory. At the royal manufactories of St. Etienne and Charleville, in France, there are inspectors appointed to see that no barrels are sent out of these places, whether for the king's use or for public sale, without being proved. The first proof is made with a ball exactly fitting the caliber, and an ounce of powder. The second is made with the same sized ball, and half an ounce of powder. The reason given for the second proof is, that the first may have strained the barrel so much, though the injury be not visible, that

that it will not bear a ſecond trial with a ſmaller charge ; and it is ſaid there really are ſome of theſe barrels which ſtand the firſt proof, and yet give way in the ſecond. Fowling-piece barrels, both ſingle and double, are proved only once, with half an ounce of powder and a ball fitting their bore.

The uſual proof of the Paris barrels is a double charge of powder and of ſhot; that is, two, or two and a half drachms of powder, and two, or two and a half ounces of ſhot. The Engliſh Tower proof, and that of the Whitechapel company incorporated by charter for proving arms, are made with a ball of the caliber, and a charge of powder equal in weight to this ball: the proof is the ſame for every ſize and ſpecies of barrel, and not repeated.

Some gunſmiths pique themſelves upon making their barrels undergo a ſecond proof; but it is proper to obſerve, that if a barrel bears any aſſigned proof, it will ſuſtain the ſame immediately after, with greater ſafety than it did at firſt, as the metal,

from being warmed by the firſt fire, expands more readily to the force of the ſecond exploſion.

Monſ. de Marolles, ſpeaking of the proofs of barrels, ſays, "A ſtronger proof than "ordinary might be made by ramming "down at top of the powder, ſix or eight "inches of dry clay, in place of a double "charge of lead. This is ſometimes em- "ployed in proving pieces of ordnance, "where, inſtead of the bullet, two feet of "clay is placed over the powder, by which "the whole force of the exploſion is ex- "erted upon the piece." We entirely agree with the ingenious author of La Chaſſe au Fuſil, in the opinion, that the proof he mentions would be *much* ſtronger than that which is uſually employed; ſo *much* ſtronger, indeed, that we do not believe any barrel could withſtand it, unleſs the clay was put down in the looſeſt manner poſſible. The hardeſt rocks are burſt aſunder by means of dry clay ſtrongly rammed over the powder that is placed at the bottom of a cylindrical cavity made in them; and we certainly cannot

not expect that a force sufficient to rend in pieces immense blocks of granite, can be resisted by the comparatively trifling strength and thickness of a gun barrel.

CHAP. V.

Caufes of Burfting.

IT may be fafely afferted, that a good barrel very feldom burfts, unlefs it be charged too highly, or in an improper manner. Whenever, for example, from the ball not being rammed home, a fpace is left between it and the powder, there is a great rifque of the barrel burfting on being difcharged. We fay *a great rifque*, becaufe, even under thefe circumftances, it frequently happens that the barrel does not burft. If the ball ftops near to the powder, a very fmall *windage* is fufficient to prevent this accident; and it is very rare that the ball touches the barrel in every part of its circumference, unlefs it has been driven in by force with an iron ramrod, in which cafe it moulds itfelf to the cavity, and blocks it up com-

completely. Should this happen, the barrel, however ſtrong it is, will burſt, even when the ſpace between the ball and the powder is but very inconſiderable; and the greater the ſpace that intervenes, the more certainly will this event take place. Mr. Robins, when ſpeaking of this matter, ſays, "A "moderate charge of powder, when it has "expanded itſelf through the vacant ſpace "and reaches the ball, will, by the velocity "each part has acquired, accumulate itſelf "behind the ball, and will thereby be con-"denſed prodigiouſly; whence, if the bar-"rel be not of an extraordinary ſtrength in "that part, it muſt infallibly burſt. The "truth of this I have experienced in a very "good Tower muſquet, forged of very tough "iron; for, charging it with twelve penny-"weights of powder, and placing the ball "(looſely) ſixteen inches from the breech; "on the firing of it, the part of the barrel "juſt behind the bullet was ſwelled out to "double its diameter, like a blown bladder, "and two large pieces of two inches long "were burſt out of it."

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The ſame accident will often take place from the mouth of the piece being filled with earth or ſnow, as ſometimes happens when we are leaping a ditch with the muzzle of the piece pointed forwards; and if in ſuch caſes the barrel does not burſt, it is becauſe theſe foreign bodies ſtop it up but very looſely. For the ſame reaſon a barrel will certainly burſt, if fired when the muzzle is thruſt into water but a very little depth below the ſurface; the reſiſtance given to the paſſage of the inflamed powder through the mouth of the piece being, in this caſe, much greater than that afforded by the ſides of the barrel.

Except in the circumſtances mentioned, or in caſe of an overcharge, it is, as we have before obſerved, very rare that a barrel burſts. Whenever it happens independent of theſe, it is from a defect in the work, and that either the barrel has been imperfectly welded, or that a deep flaw has taken place in ſome part of it; or laſtly, that, through want of care in the boring or filing, it is left of unequal thickneſs in its ſides.

The

The laſt defect is the moſt common, eſpecially in low-priced barrels; and as pieces more frequently burſt from it, than from the other defects, it ought to be particularly guarded againſt. The elaſtic fluid which is ſet looſe by the inflammation of the powder, and which endeavours to expand itſelf equally in every direction, being repelled by the ſtronger parts, acts with additional force againſt the weaker ones, and frequently burſts its way through them; which would not have been the caſe, had the ſides been of the ſame thickneſs and ſtrength, and not afforded an unequal repercuſſion. The weakneſs of any part of the barrel, occaſioned by the inequality of the caliber, will ſtill more certainly be the cauſe of burſting, than that produced by the filing; becauſe, the inflamed fluid being ſuddenly expanded at the wider part, muſt ſuffer a compreſſion before it can paſs onward, and the whole force is then exerted againſt the weak place; for gunpowder acts in the radii of a circle, and exerts the ſame force on every part of the circumference of the circle.

The

The conclufion to be drawn from all this is, that a thin and light barrel which is perfectly *upright*, that is, of equal thicknefs in every part of its circumference, is much lefs liable to burft than one which is confiderably thicker and heavier, but which, from being badly filed or bored, is left of unequal ftrength in its fides.

In all that we have hitherto faid upon the caufes of burfting, the bad quality of the iron has not been taken into account, becaufe we have fuppofed that the perfons for whofe information this Effay is chiefly intended, do not either purchafe or ufe very ordinary barrels; and we do not know any means of enfuring againft the defects of a barrel, whether arifing from the badnefs of the metal, or from the infufficiency of the workmanfhip, except by purchafing from a gunfmith of eftablifhed reputation, and giving a good price for the piece. But by this we do not mean to fanction the practice of many of the gunfmiths in the fafhion of the day: we are confident in our opinion that moft of their barrels are made

too

too thin; and it may fairly be doubted whether they have at all improved the quality of the metal. In ſome experiments which we made with a barrel of the celebrated *Lazaro Cominazzo*, whom we have before had occaſion to mention, and which was five feet ten inches in length, and extremely thin, particularly towards the muzzle, it was obſerved, that the barrel vibrated ſo much after the exploſion of the charge, as to produce a whizzing or ringing ſound that might be heard to a conſiderable diſtance from the barrel. And yet this piece, notwithſtanding its extreme thinneſs, was fired with very high charges. The iron appeared to be of an extraordinary fine quality, which goes to prove that the coheſion of the particles of the metal is the force which reſiſts that of the powder; and hence great advantage might be drawn to the manufacture of barrels, from an accurate knowledge of the force of powder, and the velocity of the ball. For theſe points being once determined, it might be known how ſtrong the barrel ſhould be, by which all unneceſſary waſte of metal might

be

be ſpared on the one hand, and all danger avoided on the other. For a force equal to that which impels the ball is exerted on the inſide of the piece; and if the barrel has not ſufficient ſtrength to reſiſt this force, it muſt of neceſſity burſt. In the examination of thoſe principles, ſome authors of great eminence and authority have aſſerted, that the greateſt force which the piece has to withſtand, is at the firſt inſtant of the exploſion before the ball ſenſibly moves out of its place, and that this force conſtantly diminiſhes as the ball approaches the muzzle: on this ſubject however we reſerve our opinion for a ſubſequent diſcuſſion.

CHAP. VI.

Of the Recoil.

IN ſire arms of every ſpecies, the exploſion is invariably attended with a greater or leſs retrograde motion of the piece; this is termed the *recoil*. It is only, however, when it is *exceſſive*, that it becomes an object of attention to the ſportſman, or renders it neceſſary to determine the cauſes from which it ariſes, ſo as to enable the gunſmith to avoid or remove them. The moſt frequent cauſe of exceſs in the recoil is, the bore of the piece being wider at one place than at another; for although this inequality be ſo ſmall as to be imperceptible to the eye, the repulſe which the expanding flame meets with when paſſing from the wider to the narrower part, renders the recoil much greater than it would have been had the

bore been perfectly cylindrical. It is an invariable law in mechanics, that *action and reaction are equal*; it follows, therefore, that *the weight of the piece being the same, the recoil will be in proportion to the quantity of the powder, and the weight of the ball or shot*; and that, *with the same charge, the recoil will be in proportion to the weight of the piece*; or, *the lighter the piece, the greater the recoil.*

In plainer language, the impelling force of the gunpowder is the first and most simple cause of fire arms recoiling; for this force acts equally on the breech of the piece and on the ball; so that if the piece and ball were of equal weight, and other circumstances the same, the piece would recoil with the same velocity as that with which the ball issues out of the piece.

For the same reason, whatever retards the exit of the charge operates like an increase of lead, and, by confining the force of the explosion the more to the barrel, produces a greater recoil; hence partly it is, that in proportion as the barrel becomes foul within

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by repeated firing, the recoil increafes. A piece will recoil, if, from the breech-plug being made too fhort, there remain fome turns of the fcrew not filled up; thefe hollows, wherein a part of the powder is lodged, forming an obftacle that confines and retards the explofion. A barrel mounted on a ftock that is very ftraight, will recoil more than when mounted on a ftock that is confiderably bent, as the curvature ferves to break and deaden the force of the recoil: and, fometimes alfo, a fowling piece will recoil from the fhooter applying it improperly to his fhoulder; for if the butt is not applied clofely to the fhoulder, or is applied fo as to be fupported only at a fingle point, the recoil will be much more fenfibly *felt*, than when the hollow of the butt embraces the fhoulder, and is firmly fupported by the weight of the body. Guns are obferved to recoil more after being fired a number of times, than they did at the beginning. The matter which is left upon the infide of the barrel after the explofion, and which increafes on every difcharge, attracts moifture

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very quickly; eſpecially if the ſaltpetre employed in the powder was not well purified from the admixtures of common ſalt which it contains in its rough ſtate. This moiſture becomes conſiderable after a few diſcharges, and, being formed into vapour by the heat, during the exploſion adds its expanſive effort to that of the inflamed powder, and greatly increaſes the agitation and recoil. Owing to this cauſe, probably, rather than to that before mentioned, ariſes the recoil from ſome turns of the breech-ſcrew not being filled up by the breech-plug, and thereby affording a lodgment to moiſture.

Among the variety of cauſes to which the exceſſive recoil of pieces has been attributed, there is one which yet remains to be conſidered; this is, the touch-hole's being placed at ſome diſtance from the breech-plug, ſo that the powder, inſtead of being fired at its baſe, is fired near the centre of the charge; whence, it is ſaid, the recoil is increaſed, and the force of the diſcharge weakened, by the effort of the powder being exerted more upon the breech than upon the ball

or ſhot. With this idea in view, ſome gunſmiths form a channel or groove in the breech-plug, as deep as the ſecond or third turn of the ſcrew; the touch-hole opens into this channel, and the powder is thereby fired at its very loweſt part; and this, they aſſert, increaſes the inflammation and the force of the powder. That the diſtance of the touch-hole from the breech, however, has very little, if any ſhare in the increaſe of the recoil, we ſhall prove in the moſt ſatisfactory manner from experiments made purpoſely to determine this matter. As to the idea, that the force of the diſcharge is *diminiſhed* by the *increaſe* of the recoil, it is too abſurd to require diſcuſſion: the force exerted by the powder upon the breech, is always equal to that which it exerts upon the ball or ſhot; ſo that if there be nothing in the barrel that retards the exit of the ball, an increaſe in the recoil will be always attended with an increaſe in the force of the diſcharge.

The following experiments were made by Monſ. Le Clerc, who is gunſmith to the

king of France, and well informed upon every ſubject that relates to his profeſſion; they were communicated by him to Monſ. de Marolles.

Theſe experiments were made with a barrel which was 30 French inches in length (nearly 32 Engliſh meaſure), and weighed, together with the loaded plank upon which it was fixed, twenty-eight pounds. The barrel had four touch-holes which could be ſtopped with ſcrews. The charge conſiſted of one drachm and twelve grains of powder from a royal manufactory, and of one ounce eighteen grains of ſhot called *ſmall* 4. This was fired at a ſheet of paper meaſuring 20 inches by 16, French meaſure; placed at the diſtance of 28 toiſes, or nearly 45 ordinary paces. The only difference was, that in the firſt ſet of experiments the wadding conſiſted of card-paper, and in the ſecond of hat, both cut to fit the caliber.

Had theſe trials been made with no other view than to determine the degree of recoil produced by the different ſituation of the touch-hole, there would have been no uſe

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in marking the ſize of the ſhot, the diſtance and dimenſions of the mark, and the number of grains thrown into it at each diſcharge. It was, however, intended to try at the ſame time, how far the equality of the diſcharges could be depended upon, with regard to the number of grains that ſtruck a given ſpace; and we ſhall have occaſion hereafter to make ſome remarks upon the reſult of the trials in this reſpect.

N. B. The French foot is three quarters of an inch longer than the Engliſh foot, and the French *inch* is divided into twelve *lines*.

We have thought it better to inform the reader of this, and leave the table as it is, than make any fractions in the numbers by reducing it to Engliſh meaſure.

First Set.—Wadding of Card-paper.

	Difcharge.	Recoil. Foot	Inch.	Lines	Mean	No. of grains thrown into the mark.	Mean.	
Touch-hole clofe to the breech-plug.	1	1	0	3	0 11 $6\frac{2}{3}$	36	27	Mean of all. 28
	2	0	10	3		14		
	3	1	0	3		31		
Touch-hole two lines from the breech-plug.	1	1	3	9	1 3 0	45	34	
	2	1	2	0		33		
	3	1	3	3		26		
Touch-hole fix lines diftant.	1	1	0	10	1 0 6	8	25	
	2	0	11	11		20		
	3	1	0	9		18		
Touch-hole twelve lines diftant.	1	1	1	7	1 1 $0\frac{2}{3}$	27	26	
	2	1	0	3		17		
	3	1	1	4		35		

Extremes 0. 10. 3 & 1. 3. 3—Mean recoil 1. 1. 0—Extremes 14 & 45

Second Set.—Wadding of Hat.

	Difcharge.	Recoil. Foot	Inch.	Lines	Mean	No. of grains thrown into the mark.	Mean.	
Touch-hole clofe to the breech-plug.	1	1	1	1	1 2 $4\frac{1}{3}$	40	51	Mean 45
	2	1	4	0		78		
	3	1	2	0		37		
Touch-hole two lines diftant.	1	1	0	7	1 2 $0\frac{1}{3}$	44	41	
	2	1	2	3		40		
	3	1	3	3		41		
Touch-hole fix lines diftant.	1	1	3	3	1 3 1	32	45	
	2	1	2	9		50		
	3	1	3	2		53		
Touch-hole twelve lines diftant.	1	1	4	5	1 3 $1\frac{2}{3}$	60	44	
	2	1	2	7		21		
	3	1	2	5		51		

Extremes 1. 0. 7 & 1. 4. 5—Mean recoil 1. 2. $8\frac{1}{2}$—Extremes 21 & 78

From

From theſe experiments it appears, that, with regard to the *recoil*, the diſtance of the touch-hole from the breech is of little importance. The only circumſtance, therefore, to be attended to in its ſituation, is, that it be not placed quite cloſe to the breech-plug; for although that part of the barrel where the powder is lodged, dirties much leſs than a few inches farther forward, yet the touch-hole when cloſe to the breech-plug, is found to be more frequently ſtopped up than when ſituated about a quarter of an inch from it.

CHAP. VII.

Range of Barrels.

THE lightneſs of fowling pieces of a moderate length, and the eaſe with which they are managed, are advantages ſo obvious, and at the ſame time ſo conſiderable, as to give them a general preference at this time; but as the circumſtances upon which only this preference ought to be reſted are little known, it is not ſufficient that their uſe is general, and daily increaſing, unleſs it be determined what are the comparative excellencies and defects of long and ſhort barrels, and it be thence ſhewn whether ſportſmen ſacrifice one advantage to gain another.

It is not more than fifty years ſince it was firſt ſuggeſted as a doubt, whether long barrels carried farther than ſhort ones. Formerly every ſportſman was provided with pieces

pieces of different lengths: the ſhorteſt was from 30 to 34 inches in the barrel, and was employed for ſhooting in cover, where a long piece would be inconvenient; whilſt that for the open country was from 42 to 45 inches in the barrel.

The generally received opinion upon this ſubject is, that, to obtain an increaſe in the range, the barrel muſt not only be made longer than uſual, but that the length and the diameter of the bore ought to bear a certain proportion to each other, and the charge of powder be ſuited to this proportion; becauſe, as it is ſaid, when the barrel is too ſhort, the ball or ſhot quits it before it has received the whole impulſe of the powder; and, on the other hand, when the barrel is too long, that the powder is not only all inflamed, but even partly conſumed, before the ball or ſhot arrives at the mouth of the piece. It was upon this theory that Balthazar Killar, a celebrated cannon founder in the reign of Louis XIV. reſted his opinion, when aſked by Monſ. Suriry de St. Remy, whence it was that the culverin of Nancy,

Nancy, which was 22 feet in length, did not carry a ball as far as a shorter piece was found to do: his answer was—" The powder when inflamed ought to quit the cavity of the piece in a certain time, in order to exert its whole force upon the bullet; by a longer stay part of the force is lost; and the same cause may produce an inequality in the shots, by giving a variation to the bullet, so as to destroy its rectilineal course, and throw it to one side or other of the mark." See Memoires d'Artillerie de St. Remy, tom. i. p. 117.

Such also is the reasoning employed by Nicola Spadoni, who has treated expressly upon the subject of fowling pieces, in a little work entitled *La Caccia dello Schioppo*. This author even goes so far as to determine the exact proportion that ought to obtain between the length and the caliber of gun barrels, and then proceeds to assign the quantities and qualities of the powder and shot suited to these respective dimensions. He is of opinion, that the powder should be coarser grained for long and wide barrels,

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than for such as are short and of a small caliber, and this in proportion to the space it has to pass through in the one and in the other; he thinks the grains ought to be larger for long pieces, because in these more time is given for the powder to be inflamed; and that where large grains are completely inflamed, they act with greater force upon the ball or shot than small ones do. Lastly, he says, the powder should be fine for short barrels, because the small grains inflame more suddenly than the large ones.

In order to prove that the large grained powder is stronger than the fine kind, he mentions the circumstance of powder having its explosive force diminished by the grains being broken down, or ground into *meal powder* as it is called *.

With

* It is a well known fact, that the explosive quality of powder is almost destroyed by the powder being ground fine; but it does not follow from thence, that large grained powder is stronger than that which is small in the grain; on the contrary, it would appear even from Spadoni himself, that the latter is the stronger, for he allows that it inflames more rapidly. The committee

With regard to the ſhot, he prefers that of a large ſize for long barrels; becauſe, he ſays, the grains by their weight oppoſe a greater reſiſtance to the powder, and by their diameter acquire a greater velocity *. Spadoni

mittee of the Royal Society appointed to examine the poſition of Mr. Robins, *that all the powder was inflamed before it left the barrel*, found, that the particles collected after the exploſion were much fewer when the powder was ſifted, and the ſmall grains only employed: as the *inflammation*, therefore, was more complete, ſo we would conclude the *force* of the exploſion to have been greater in the one caſe than in the other; and conſequently that ſmall grained powder is the beſt for every ſized barrel. Some further remarks on this ſubject are, however, introduced in a ſubſequent part of this work, and to which the reader is referred.

* As long barrels are intended for killing at a diſtance, Spadoni is right in preferring large ſhot for them, but not on account of the reaſons he has aſſigned; becauſe they neither oppoſe a greater reſiſtance to the powder, nor are they projected with greater velocity. The grains, whether large or ſmall, paſs through the barrel with equal velocity, provided the quantity of powder, and the *weight* of the ſhot employed, be the ſame. The diſtance to which they fly, however, will be very different; for as the reſiſtance oppoſed by the air is in proportion to the ſurface, the whole retarding

Spadoni has formed a table, in which he has ſet down the proportions he ſo ſtrongly inſiſts upon; but as his deductions are moſtly drawn from falſe premiſes, his arguments, however ſpecious, ought not to weigh againſt thoſe that are reſted upon eſtabliſhed principles, and which are found to bear the teſt of experiment.

From the theory of which we have juſt given a detail it appears, that the ſuperior range of long barrels was founded entirely upon the opinion, that *the powder fires gradually all the time it is paſſing through the barrel.* The concluſion neceſſarily drawn from this was, that the larger the charge, the longer time it was in kindling; and hence, that *for any aſſigned charge, the barrel muſt be of a proportional length, ſo that the powder may*

ing force (which ariſes from a compariſon of the reſiſtance with the quantity of matter to be moved) will be exactly in the inverſe proportion of the diameter of the different ſized ſhot employed: hence a muſquet ball of an ounce weight, fired with one ſixth its weight of powder, will range nearly twice as far as a pellet weighing but one eighth of an ounce, fired with the ſame proportion of powder.

be

be completely inflamed just as the ball or shot are about to quit the muzzle. The converse of this proposition was, that *in every piece there is a certain charge which will be all fired just at the parting of the ball or shot from the mouth of the piece, and that any addition of powder will not take fire, but will only serve, by its weight, to diminish the action of the rest, and, consequently, to retard the velocity of the shot or ball.*

If this matter be considered with mathematical rigour, it must certainly be allowed, that, as the fire is not at once applied to every particle of the powder, the whole of the charge cannot be inflamed at the same instant; but it is equally certain, that the progress of the inflammation is so rapid, that the powder is completely kindled before the ball or shot arrives at the mouth of the shortest barrel ever made use of.

To determine this, a number of experiments were made by a committee of the Royal Society, so long ago as the year 1743*;

* Philosoph. Transact, No. 465. p. 172.

and

and by theſe it was ſhewn, that, when a barrel was ſhortened ſo much that the ball placed before the powder was upon a level with the muzzle, the unſired powder, collected from the diſcharge by means of a cloth ſpread before the piece, weighed but one *twelfth* of the charge. This was analyſed, and found to contain leſs ſaltpetre than an equal portion of the ſame powder did. Hence, and from the extreme minuteneſs of the particles collected, there was reaſon to believe, that the grains to which they belonged were leſs ſuſceptible of inflammation than the reſt, owing, perhaps, to ſome inequality in their mixture: what ſerved in a great meaſure to prove this, was, that when the charge, and conſequently the heat generated during the exploſion, was increaſed, the quantity of unſired powder collected was proportionally ſmaller. And we may therefore ſafely conclude, that *the powder is completely inflamed before the ball or ſhot arrives at the mouth of the ſhorteſt barrel ever employed.*

Having now removed the ground upon which

which the ſuperior range of long barrels was formerly reſted, it is neceſſary that we ſhould endeavour to ſhew upon what circumſtances it does really depend, and to what extent it is found to take place.

The elaſtic fluid produced by the firing of gunpowder is found, by experiment, to occupy, when cooled to the temperature of the atmoſphere, a ſpace 244 times greater than that taken up by the powder from which it was obtained. But from the heat generated during the exploſion, this elaſtic fluid is rarefied to upwards of four times its former bulk. The expanſive force of this fluid, therefore, is, at the moment of inflammation, *one thouſand* times greater than that of common air, or, which is the ſame, than the preſſure of the atmoſphere; or, ſuppoſing the powder to have occupied the ſpace of one cubic inch, its expanſive force, when fired, is equal to that which would be exerted by *one thouſand* cubic inches of common air compreſſed into the ſpace of *one* inch.

As the velocity with which the flame of gun-

gunpowder expands when uncompreſſed, is much greater than that with which the ball, or ſhot, moves forward, the flame muſt continue to preſs upon the ball, and add to its velocity, until it quits the mouth of the piece. This preſſure, however, becomes leſs and leſs, as the ball proceeds, and ceaſes entirely when it leaves the muzzle, in conſequence of the flame being then allowed to expand itſelf laterally. Thus, for example, if the charge of powder takes up *one* inch of the barrel, and the whole length of the barrel be *thirty* inches, then, when the ball arrives at the muzzle of the piece, the inflamed powder (whoſe expanſive effort is in proportion to the ſmallneſs of the ſpace it occupies) extends through *thirty* times the ſpace it did when the ball began to move, and conſequently preſſes forward with but *one-thirtieth* part the force it poſſeſſed at firſt. Moreover, although the *velocity* of the bullet is continually increaſed by this preſſure of the inflamed powder, its *acceleration* becomes leſs and leſs as it proceeds through the barrel; for beſides

 that

that the quantity of the preſſure diminiſhes as the flame expands, the bullet continuing to move faſter and faſter, muſt receive continually leſs and leſs addition of impulſe from the flame preſſing behind it. Hence, if two pieces of the ſame bore, but of different lengths, are charged with the ſame quantity of powder, the longer piece will, ſtrictly ſpeaking, communicate the greater velocity and force to its ball, or ſhot. But as the inflammation of the powder has been ſhewn to be *nearly* inſtantaneous, and as the increaſe of acceleration which the ball or ſhot receives after the firſt impulſe of the powder upon it, is not very conſiderable; it follows that the force with which two barrels of the ſame bore, and with the ſame charge, throw their ball or ſhot, will be nearly the ſame, unleſs their lengths be *extremely* diſproportionate.

To prove this, and to corroborate the experiments made by ourſelves upon the ſubject, we ſhall quote what is ſaid by that able mathematician and engineer, the late Mr. Benjamin Robins, to whoſe work we

are indebted for much valuable information.

"If a musquet barrel of the common "length and bore, be fired with a leaden "bullet and half its weight of powder, and "if the same barrel be afterwards shortened "one half, and fired with the same charge, "the velocity of the bullet in this shortened "barrel will be about *one-sixth* less than "what it was when the barrel was entire; "and if, instead of shortening the barrel, it "be increased to twice its usual length "(when it will be near eight feet long), the "velocity of the bullet will not hereby "be augmented more than one-eighth part. "And the greater the length of the barrel "is in proportion to the diameter of the "bullet, and the smaller the quantity of "powder, the more inconsiderable will "these alterations of velocity be."

When the allowances which Mr. Robins here takes notice of, are made in the proportion required for fowling pieces, the result will be found to correspond exactly with the experiments which we have re-

peatedly made, with every poſſible attention to accuracy. We have, at different times, compared barrels of all the intermediate lengths between 28 and 40 inches, and of nearly the ſame caliber, that is to ſay, from 22 to 26; and theſe trials were made both by firing the pieces from the ſhoulder, and from a firm block, at an equal diſtance, and with equal weights of the ſame powder and of the ſame ſhot.

To avoid every poſſibility of error, the quires of paper at which we fired, were fixed againſt planks, inſtead of being placed againſt a wall. From theſe trials frequently repeated, we found that the ſhot pierced an equal number of ſheets, whether it was fired from a barrel of 28, 30, 32, 34, 36, 38, or 40 inches in length. Nay more, we have compared two barrels of the ſame caliber, but one of them 33, and the other 66 inches long, by repeatedly firing them in the ſame manner as the others, at different diſtances from 45 to 100 paces, and the reſults have always been the ſame, *i. e.* the barrel of 33 inches drove its ſhot

through

through as many ſheets of paper as that of 66 did. The concluſion from all this, is, that the difference of *ten* inches in the length of the barrel, which ſeems to be more than is ever inſiſted upon among ſportſmen, produces no ſenſible difference in the range of the piece; and therefore, that every one may pleaſe himſelf in the length of his barrel, without either detriment or advantage to the range*.

The

* As we have preſumed to lay down the foregoing principles, and which we have ventured to adopt on the great credit of our countryman Robins; it is but fair to ſay, that he was in his own time, and has been ſince, very plauſibly, if not ably, controverted by foreign engineers of great repute; and therefore it may not be altogether unacceptable to our readers, to give a brief ſtatement of ſome of the arguments and experiments advanced in oppoſition to his doctrine. Robins, in his propoſition for determining the velocity which a ball acquires from the exploſion, aſſumes two principles: Firſt, That the action of the powder on the ball ceaſes as ſoon as the ball is got out of the piece. Second, That all the powder of the charge is fired, and converted into an elaſtic fluid, before the bullet is ſenſibly moved from its place. From theſe prin-

ciples,

The circumſtance of a duck-gun killing at a greater diſtance than a fowling piece, is

ciples, if true, it would naturally follow, that a tolerable ſized piſtol would carry as far as a gun-barrel of an ordinary length—a poſition ſo abſurd, that we cannot dwell on it a moment; or which leaves us to ſuppoſe that the powder which Robins uſed was ſo chemically excellent, that the greateſt part of it in his experiments fired before the ball made its exit out of the ſhorteſt barrel. And yet we have reaſon to believe that this author, after the report made by the committee of the Royal Society appointed to ſuperintend his experiments on this ſubject, qualified his former aſſertions, and admitted that ſome grains are often obſerved in the powder which reſiſt the force of the flame ſome time before they fire. Indeed, the difficulty of aſcertaining with certainty the complete inflammation of the powder muſt neceſſarily be very great; for it may happen that a conſiderable part of the powder is blown out unfired, yet fires before the muzzle, and is of no effect in impelling the ball, although theſe grains do not fall to the ground unfired: for the flame before the muzzle ſeems ſufficiently fierce to fire and conſume any part of the powder that did not fire in the barrel, by reaſon of its ſhort continuance there. And may it not alſo be ſuppoſed that ſome ſmall part of the charge is not rammed up with the reſt, but is left in the piece before the wad, as well as that the gradual

is not owing to its *length*, but to its greater weight and thickneſs allowing the charge of

dual firing of powder muſt be different in different ſorts?

The following is an account of ſome experiments made by General Gunther at Peterſburg, in preſence of ſeveral members of the academy there, as well as of engineers of the firſt reputation, purpoſely to aſcertain whether the total exploſion of powder was, or was not, inſtantaneous: to which we have added a ſmall abſtract of the remarks and obſervations of an ingenious and learned commentator on the works of Euler, relative to the ſame ſubject.

The firſt experiment was made with a piece whoſe cylinder was $7\frac{7}{10}$ Engliſh feet long, which was fired vertically, with different charges of powder and a ball of the caliber. The time from the exploſion until the ball's return to the ground was exactly obſerved by means of a pendulum; from which Monſ. Bernoulli computed the velocity with which the ball iſſued out of the piece; and from the calculation he found that the piece being loaded with 1, 4, and 8 ounces of powder, the ball muſt have aſcended in vacuo 541, 13694, and 58750 feet. Then $1\frac{7}{10}$ foot was ſawed off the piece, ſo that the cylinder was exactly 6 feet long; the piece was then fired with the ſame charges of 1, 4, and 8 ounces of powder; and he found that in vacuo the ball muſt have aſcended only 274, 2404, and 6604

 feet:

of powder to be doubled, trebled, or even quadrupled; which cannot be done in a fowling

ſect: ſo that the eight ounces of powder carried the ball nearly nine times higher before than after ſhortening the piece; and therefore the velocity with which the ball iſſued out of the piece muſt have been about three times greater in the firſt caſe than in the laſt.

But, according to the theory of Robins, the difference muſt have been ſcarcely perceptible; and hence it appears that, before the piece was ſhortened, a good part, indeed the greateſt part, of the powder fired whilſt the ball moved through the laſt foot and a half of the cylinder.

The ſame concluſion follows in the leſſer charges, although the difference in them is not ſo great; and hence it likewiſe appears, that, the greater the charge is, the more time will be employed before it all fires; which of itſelf is almoſt ſelf evident.

The rifled barrel, which is known to carry a ball much farther than a barrel not rifled, is another proof that the powder does not fire all at once; for, if it did, the rifled barrel would not carry near ſo far as the other. For, conſidering the great reſiſtance the ball has to overcome in a rifled barrel, even if we neglect the motion of the ball round an axis, which requires a force to effect it, there cannot be the leaſt doubt entertained about it; yet, notwithſtanding this great reſiſtance, a ball acquires a greater velocity when fired out

fowling piece, though ſtrongly reinforced. For a barrel of five or ſix feet, ſuch as that of

out of a rifled than when fired out of a common barrel, when every thing elſe is the ſame. There muſt therefore be a much greater force exerted in a rifled than in a common barrel, to overcome the reſiſtance, and alſo to communicate a greater velocity to the ball. This force is generated by the powder only, which is in both caſes the ſame. There can be no cauſe aſſigned why the force ſhould be greater in one than the other, except that in the rifled barrel all the powder, or at leaſt the greateſt part, fires before the ball quits the piece; and that a ſmaller quantity fires in a common barrel. The laſt argument ſeems to throw the greateſt light upon the matter in hand, as it proves not only that the powder does not fire all at once, but that only a ſmall portion of it commonly fires before the ball is out of the piece. For which reaſon the opinion of Monſ. Bernoulli becomes the more probable, namely, that the elaſtic fluid generated by the exploſion of the powder, has an elaſtic force near 10,000 times greater than the preſſure of the atmoſphere, notwithſtanding that Robins makes it only 1000 times greater.

A variety of other experiments and arguments might here be introduced on this ſubject: but, as thoſe we have juſt mentioned ſeem to compriſe the principal objections to the doctrines of Robins in this controverſy, we will not take up the time and patience of the reader by

of a common duck-gun, weighing five or ſix pounds, and the whole piece twelve or thirteen pounds; may be fired with a very large charge, without recoiling ſo much as to hurt the ſhooter, its weight being ſufficient to reſiſt the violent impulſe occaſioned by the increaſe of the powder. But in a fowling piece of three feet barrel, ſufficiently ſtrong to withſtand ſuch a charge, and whoſe weight altogether does not exceed five or ſix pounds, the recoil would be inſupportable. Beſides, they not only double or treble the powder in a duck-gun, but they put in a much greater quantity of ſhot than is ever employed in a fowling piece.

Duck-guns are generally bent a little upwards near the muzzle, which, the gunſmiths ſay, makes them throw their ſhot farther than if they were perfectly ſtraight.

To obtain, therefore, from a piece of the

by adducing any more, leaving him for the preſent to form what opinion he pleaſes, and declaring that at this time we cannot deciſively ſay what is our own.

ordinary

ordinary length, the ſame effects as from a duck-gun, nothing more, perhaps, is neceſſary than to have the barrel ſufficiently ſtrong to admit of the charge being doubled or trebled as required, and the whole piece heavy enough to render the recoil ſupportable. We may here obſerve, however, that an increaſe of the powder above the charge generally uſed, does not produce a proportional increaſe of range in the ball or ſhot: thus a double charge of powder will not throw the ball or ſhot to twice the diſtance, nor a treble charge to three times the diſtance, the ſingle charge does. This ariſes from the great reſiſtance given by the air to the motion of the ball or ſhot, and which is proved to be fourfold if the velocity be doubled, and ninefold when it is trebled by an increaſe of the powder; for the reſiſtance of the air is not proportional to the velocity itſelf, but only to the ſquare of the velocity. Thus *Bernoulli*, a profeſſor in *Baſil*, diſcovered from experiment that a ball which, being fired, aſcended only 7819 feet in the air, would aſcend 58,750 feet in

vacuo.

vacuo. Still we may ſafely infer, that, if the action of the powder is not diminiſhed by circumſtances of defect in the formation of the barrel, the greater the force of the powder, the greater muſt be the velocity of the ball.

So great is the change in opinion of late, with regard to the proper length for gun barrels, that many gunſmiths will now tell us, that ſhort barrels carry *farther* than long ones; and the reaſon they give for this, is, the greater friction of the ball or ſhot in paſſing through a long barrel, by which their velocity is retarded and their force diminiſhed. If the barrel be ſo long that the additional impulſe which the ball or ſhot is continually receiving in its paſſage, becomes leſs than the friction between them and the ſides of the caliber, then, indeed, the barrel by being ſhortened will ſhoot with more force: but as the length of barrel required to produce this effect, is vaſtly greater than can ever be employed for any purpoſe, the objection does not hold. And it ſeems clear, that a piece may be made ſo long that

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it will not throw a ball with ſo great a velocity as one that is conſiderably ſhorter; and the reaſon of this decreaſe of velocity may be, that in very long pieces the increaſe of the counterpreſſure of the external air in the cylinder may greatly exceed the force of the powder, and that the elaſtic fluid generated by the exploſion of the powder is conſtantly eſcaping whilſt the ball paſſes along the cylinder, which it not only does at the touch-hole, but alſo between the ball and the ſides of the barrel; and hence may be inferred the neceſſity of touch-holes which do not prime of themſelves, and of wadding that ſtops the barrel hermetically.

Having now, we hope, thrown every light upon this queſtion, that is neceſſary to determine us in our choice of the *length*, it will, perhaps, be expected that we give our opinion, what length of barrel is beſt calculated for general uſe. The barrels which we ourſelves employ, and which we have found to anſwer beſt for every purpoſe, are from 32 to 38 inches; and whether we

conſult

consult the appearance of the piece, its lightness, or the ease with which it is managed, we believe that a barrel not exceeding the one, or below the other of these numbers, is the most eligible. We know that many of the fashionable gunsmiths pique themselves on the proportions they give to the different parts of their fowling pieces, and thence deduce a superiority over their cotemporaries in favour of their own: to us it appears that the beauty of those proportions is more attended to, than any good reason why they are made so rather than otherwise.

CHAP. VIII.

On the Shot of Fowling Pieces.*

WE often hear of fowling pieces which throw their whole charge of ſhot into the breadth of a hat at the diſtance of forty or fifty paces; and ſo generally is this believed among ſportſmen, that it is no uncommon thing to hear gentlemen telling

* We have here employed a word whoſe propriety, in the ſenſe we have taken it, may certainly be diſputed, but were obliged to do it for want of a better. By the *ſhot* of a barrel, we mean to expreſs the cloſeneſs and ſteadineſs with which it throws its charge of ſhot againſt any object; whilſt the *range* relates to the *diſtance* to which a ball or ſhot is thrown, without conſidering whether it flies in a ſtraight line or not: or it may be conſidered as relative to the excellence or the defect of a barrel's ſhooting. By way of diſtinction we have put the word *ſhot* in italics, when employed in the ſenſe here mentioned.

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the gunſmith, that they expect the piece they are ordering will do the ſame. It will therefore appear very extraordinary, if, in defiance of this general prejudice, and of the remarks ſo frequently made, that "this piece ſhoots extremely cloſe," and "that ſcatters prodigiouſly," we ſhould make it a queſtion, whether ſome barrels throw their ſhot more cloſely than others do; but ſtill more ſo, if we decided the queſtion with a negative, and this from various experiments, made on purpoſe, and frequently repeated in order to ſatisfy ourſelves of the fact.

The few who have made this matter the ſubject of experiment, know that the cloſeneſs or wideneſs with which a piece throws its charge, is liable to an infinite number of variations; and that, whether from circumſtances that are merely accidental, or from others, which, being unknown, cannot be prevented, the grains of ſhot compoſing the charge, may, at the inſtant of exploſion, arrange and combine themſelves ſo differently, that all the trials they can make will never produce reſults ſufficiently uniform to draw

draw any general conclufion from, or to convince perfons not already prejudiced, and who will take the trouble to examine before they decide.

We have fired the fame piece from a reft, twenty times in fucceffion, with the fame charge of powder and of fhot, and at the fame diftance; and have, during the courfe of the firing, thrown into the mark from 30 to 70 grains, with all the intermediate numbers. We have repeated this trial a great many times with the fame piece, and alfo with different pieces at the fame time, without having ever obferved fo much uniformity in the fame piece, or difference in different pieces, as to give room for preferring one piece to another. The experiments made by Monf. Le Clerc (fee the table, page 70) ferve to confirm thefe. It is worthy of notice, however, that in the fecond fet of experiments, the number of grains thrown into the mark is uniformly greater than in the firft fet, although, as we have already mentioned, the only difference between them was, that, in the firft fet, the

wadding was made of card-paper, and in the ſecond, of hat, both cut to the ſize of the caliber: are we to attribute the difference in the reſults to this circumſtance?

In firing with ball it is obſerved, that the better the ball fits the piece, or the leſs *windage* there is, the greater will be the force of the diſcharge. This evidently depends upon the flame not being allowed to eſcape paſt the ball; and probably in the caſe of ſhot the wadding of hat may be preferable to that of card or paper, by diminiſhing the windage; or rather, perhaps, by preventing the flame from getting among the grains of ſhot, and diſperſing them by its lateral expanſion when it has quitted the muzzle.

The firſt conjecture might be determined, by comparing the cloſeneſs or diſperſion of different diſcharges, in ſome of which tow, in others paper or card, and in others hat, was employed for wadding. The ſecond alſo might be decided by varying the ſituation of the piece of hat; thus, for inſtance, we might one time place it between the

powder and ſhot, with a ſmall wadding of tow over the ſhot; and at another time place the tow next the powder, and the hat over the ſhot. If the hat operated by preventing the flame eſcaping paſt the ſhot, and thus leſſening the *force* of the diſcharge, there would be little, if any, difference whether it was placed above or below the ſhot. But if its good effects depend upon its hindering the flame from getting among the grains, and ſcattering them in the manner mentioned above, then the ſhot would fly more cloſely when the hat was placed between it and the powder. We are, however, inclined to conſider the latter as the true effect of hat wadding, and this from a practice that is ſaid to be ſecretly and ſucceſsfully followed by ſome perſons, when firing with ſhot at a mark, for a wager: they put in the ſhot in ſmall quantities at a time, ramming down a little tow or thin paper over each, ſo as to fill the interſtices of the grains, and thus prevent the flame from inſinuating itſelf among them.

Another opinion pretty generally eſta-

bliſhed among ſportſmen, and upon which we ſhall decide much in the ſame way we have done upon the former, is, that barrels of a ſmall caliber throw their ſhot more cloſely than thoſe of a wider one do. That the ſame number of grains ſpread over two unequal ſurfaces, and flying off from thence with equal degrees of divergency, will be found more widely ſeparated in the one caſe than in the other at any aſſigned diſtance, is a circumſtance mathematically true; but the difference in this caſe will never be greater than that of the reſpective ſurfaces from which they are diverged. Now the difference between the areas of the largeſt and ſmalleſt calibers ever employed in fowling pieces, is leſs than the error in the meaſurement of this divergence would be at ten yards from the muzzle; ſo that the greater or leſs diameter of the bore cannot produce any ſenſible difference in the cloſeneſs or wideneſs with which the ſhot is thrown, provided the charge be the ſame in both pieces. We have ſubjected this matter to the teſt of experiment, and the reſult has

has accordingly been, that a barrel of 22 or 24, which is the largeſt caliber uſually employed in fowling pieces, threw its ſhot as cloſely as one of the ſmalleſt caliber, viz. of 30 or 32.

There is a curious circumſtance attending the *ſhot* of barrels, which is, that ſometimes the grains of lead, inſtead of being equally diſtributed over the ſpace they ſtrike, are thrown in cluſters of ten, twelve, fifteen or more, whilſt ſeveral conſiderable ſpaces have not a ſingle grain in them. Sometimes a cluſter of this kind conſiſts of one-third, or one-half of the charge; and it alſo happens ſometimes, though more rarely, that the whole charge collects itſelf into one maſs, ſo as to pierce a board near an inch thick, at the diſtance of 40 or 45 paces. Small barrels are *ſaid* to be more liable to this than large ones; and Monſ. de Marolles ſays, that this is eſpecially the caſe when the barrels are new, and alſo when they are freſh waſhed. He mentions a double-barrelled piece of 32 caliber, which was particularly liable to this *cluſtering* and *lumping* of the

ſhot; but adds, that the ſame thing did not happen to him with other barrels of 26 and 28 caliber, which he had uſed before. The lumping may, perhaps, depend upon the wadding employed, acting ſomewhat in the manner we ſpoke of in page 99; poſſibly the *cluſtering* of the ſhot may proceed from the wadding doing the ſame, with a *part* of the charge. Our *conjectures* upon this matter, however, together with the means which we think moſt likely to remedy it, will come more properly under the head of the next article.

With regard, then, to the extraordinary cloſeneſs with which ſome pieces are *ſaid* to throw the ſhot, we certainly ſhall not take upon us to aſſert that the perſons who *ſpeak* of them, wiſh to deceive us; but we do moſt firmly believe that they deceive themſelves; and that their accounts proceed either from their belief that a gunſmith, by ſuperior ſkill and care, is able to make ſuch, or from their having once ſeen a piece accidentally *lump* its ſhot in the manner deſcribed above. The reſult of our experience,

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however, is very unfavourable to this prevailing opinion; for we do affirm, that, after having fired at a mark times without number, we have never yet found a barrel which, at the diftance of 50 paces, would throw its whole charge with regularity, we will not fay into the breadth of a hat, but, into a fpace of three feet fquare.

CHAP. IX.

Of the Means which have been employed to improve the SHOT *of Fowling Pieces.*

FROM the prejudices which obtain ſo generally among ſportſmen and gunſmiths, reſpecting the *ſhot* of pieces, it is very natural to ſuppoſe, that a variety of means have been ſought after and practiſed, in order to remedy this real or pretended effect of ſcattering the charge. Mr. de Marolles mentions ſeveral methods employed for this purpoſe, none of which, however, appear to be practiſed in England; and indeed, if we may be allowed to judge of them *a priori,* we believe few gunſmiths here will have faith enough to make the experiment. One of the methods he deſcribes is as follows: An iron or wooden mandril fitted to the caliber, is furniſhed at one end with ſmall

ſmall files which are cut tranſverſely only; this inſtrument being introduced into the barrel is turned round by means of a croſs-handle, and forms a great number of ſuperficial ſcratches in the metal, by which, they pretend, the defect of ſcattering the ſhot is remedied. One obvious effect of this operation, is, that of deſtroying the ſmoothneſs of the barrel within, and thereby rendering it liable to dirty the ſooner; but we cannot conceive how the ſhot ſhould be thrown cloſer by having the friction increaſed between it and the ſides of the caliber; and that this will be the caſe, is evident, from a rough barrel being always found leaded conſiderably after every diſcharge. Some make the barrel wider for three or four inches at the muzzle; and this bell-mouthed form is of very ancient date.

Eſpinar, whoſe treatiſe has been already mentioned, ſays, he has generally found this ſucceed in making barrels throw their ſhot cloſer. Were this true, we ſhould expect to find this form of the barrel more generally uſed than it is at preſent, and not hear

ſo many complaints among ſportſmen about their pieces. We cannot ourſelves perceive the ſlighteſt ground for preferring it; nay, we are decidedly of opinion that it is rather of diſadvantage to the *ſhot* of the piece, and for the following reaſons: As hat is ſeldom employed for wadding, it is ſcarcely poſſible, but that more or leſs of the flame will eſcape paſt the wadding of tow or paper, and inſinuate itſelf among the grains of ſhot; this flame will expand itſelf laterally as ſoon as it arrives at the widened part, and, by driving the grains along the ſides of the muzzle, will communicate a whirling motion to them, that will increaſe their divergency very conſiderably *.

When we conſider that the grains of ſhot which are in actual contact with the ſides of the barrel, compoſe upwards of half the charge, we cannot be ſurpriſed if enlarging the ſurface of the caliber at the

* The principles upon which this circumſtance is accounted for, will be explained very fully when we come to treat of rifle barrels, and the cauſes of variation in the flight of balls and ſhot.

muzzle,

muzzle, and thereby increaſing the number of grains that touch it, will tend to make the ſhot be ſcattered more widely. Eſpinar ſays that the fault of ſcattering the ſhot is not owing to the hand of the workman, the barrels of the beſt maſters being equally ſubject to it as thoſe of others. He is of opinion, that it ariſes from the different quality of the iron compoſing the ſeveral portions of the barrel. Thus, he ſays, it may happen that the reinforced part is formed of iron which is harder, and cloſer in the grain, than that forming the fore part of the barrel; in conſequence of which, and alſo from the fore part being ſo much thinner, the latter is the more ſhaken by the powder, and by that means produces a diſperſion of the ſhot. He therefore pretends, that widening the muzzle in the manner already ſpoken of, by facilitating the exploſion, diminiſhes the force of the powder upon this part, and cauſes the ſhot to be thrown more cloſely together.

This opinion of Eſpinar, however, not only appears abſurd in itſelf, but there is

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not even the ſmalleſt ground for it in the greater number of inſtances; the barrels which are forged in ſeparate pieces being very few indeed, compared with thoſe that are forged in a ſingle piece, and are conſequently of the ſame quality throughout: nor does it appear that the former are more liable to the fault in queſtion, than the latter are.

Some gunſmiths, ſays Monſ. de Marolles, pretend, that a barrel, in order to throw its ſhot cloſely, ought to have its caliber narrower in the middle, than at either the breech or muzzle; whilſt others, again, inſiſt that the caliber ought to contract gradually from the breech to the muzzle. With reſpect to theſe contrivances, however, we ſhall only obſerve, that they are both admirably calculated to make the piece recoil, if not to burſt it.

The ſtraight rifling of barrels, is an expedient, which, though not often practiſed, yet deſerves notice, as having the teſtimony of ſome amateurs to its efficacy in preventing the ſcattering of the ſhot. Neither the

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workmen who make theſe pieces, however, nor the perſons who uſe them, can give any ſatisfactory explanation of the principles upon which the riſling proves ſerviceable in fowling pieces; and ſome of them admit that it cannot be of any uſe, unleſs the depth and breadth of the channels, and the ſize of the ſhot, are ſuited to each other. Having never tried any of theſe pieces, we ſhall not aſſert, that they poſſeſs *no* advantage over the plain ones; but we can ſafely ſay that they are attended with ſeveral obvious inconveniencies, the chief of which is, their great weight; for the barrel muſt be made conſiderably thicker than a plain one, in order to admit of being rifled, and the additional quantity of metal in it, when finiſhed, will be in proportion to the depth of the channels, and the breadth of the threads. They are alſo more difficultly kept clean; and it is ſcarcely poſſible to prevent a conſiderable windage, let us uſe what kind of wadding we will: ſo that not only a part of the *force* of the exploſion will be loſt, but the flame,

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by getting among the grains of the ſhot, will increaſe their divergency from its lateral expanſion when the charge has quitted the muzzle. We ſhall, however, poſtpone the farther conſideration of this matter, until we have treated of rifle barrels in particular, when it will be better underſtood, and more in its proper place.

Of all the contrivances which have been mentioned, not one appears calculated to anſwer the end for which it was propoſed. The greater number of gunſmiths are ſenſible of this, and therefore very ſeldom practiſe them, unleſs to indulge the whim of their cuſtomers. As far as our reaſon and experience are ſufficient for enabling us to determine upon the matter, we would reject all the expedients that have been hitherto propoſed, and give a decided preference to the barrels as they are uſually made, *i. e.* to thoſe whoſe caliber is very ſmooth and perfectly cylindrical throughout. Barrels of this kind have long ſupported their credit among the beſt ſportſmen, whilſt the pretended improvements have all experienced

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but a very temporary reputation, and are now almoſt entirely neglected.

Would ſportſmen only forbear to determine upon the merits or defects of their pieces, until they had given them a patient and impartial trial, by varying the quantity of powder and ſhot in different ways; we are inclined to think there would be fewer complaints made of the modern fowling pieces. We can aſſert from our own knowledge, that ſeveral gentlemen have haſtily parted with their pieces, and thrown a cenſure upon the maker, which after-experience proved to be undeſerved: and we have prevented ſeveral of our acquaintance from doing the ſame, by prevailing upon them to make a farther trial with different charges. The chief ſource of error appears to be, that of overcharging; and it was generally by correcting this, that we ſucceeded in removing the bad opinion which had been entertained of many pieces. Every barrel, according to its caliber and weight, has a certain quantity of lead, and a ſuitable one of powder, which will be attended with greater

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certainty and effect than any others; and these must be determined by repeated trials. If we increase the quantity of shot above this, we lessen the force of the discharge, and at the same time increase the recoil: and if we increase the charge of powder, that of the shot remaining the same, we also increase the recoil, and disperse the shot much more than before. In every species of fire arms, large charges of powder are found to disperse the shot very much, whilst with smaller charges than are generally employed, it is thrown more steadily and closely. If the object, therefore, which we are about to fire at, be at too great a distance for the shot to take effect, and it happens that we cannot approach nearer to it, we ought not to increase the quantity of powder with a view to the shot being thereby thrown farther, as, by so doing, the increase of the *range* will be very trifling, whilst the dispersion of the shot will be greatly increased. The only expedient in this case, is, to employ shot of a larger size, the quantity of it, and of the powder, being kept the same as has

has been already found beſt ſuited to the piece.

After what has been ſaid in the preceding chapter, we cannot venture to determine what degree of cloſeneſs or diſperſion in the *ſhot*, will entitle any piece to the name of a *good* or a *bad* one; but would obſerve, that if a fowling piece charged with an ounce of No. 2. patent ſhot, and a dram of powder, throws 60 grains into a ſheet of paper 18 inches by 24, at the diſtance of 50 paces *, we may conſider it as very capital, although theſe are only about *one-third* of the charge; and that the ſame piece continuing to be fired at the ſame mark and diſtance, will not, in the mean of four or five ſucceſſive diſcharges, throw 36 grains into the paper; in ſhort, that when due attention is paid to finding the ſuitable quantity of powder, and of ſhot, one piece will perform nearly as well as another.

Although gunſmiths in general have given up the idea that fowling pieces can be made

* We do not mean geometrical, but ordinary paces.

to throw their ſhot more cloſely by any alteration in the form of the barrel, from that in common uſe; many of them are, nevertheleſs, perſuaded, that the *force* and *quickneſs* of the diſcharge may, by certain contrivances, be conſiderably augmented. As in a ſphere, the diſtance from the centre to the circumference is leſs than in any other ſolid of equal magnitude; the paſſage of the flame through the grains of powder, placed in this form, is the quickeſt poſſible, and conſequently the inflammation and exploſion muſt be the moſt rapid and powerful. Accordingly a chamber of this form, which was larger than the caliber, ſo as to contain all the charge, was once employed in artillery; but the ſtruggle of the inflamed powder, in paſſing from the chamber into the caliber, produced ſo great a ſhock upon the piece and its carriage, that the ſpherical chamber was laid aſide.

A chamber of this form is, for many reaſons, ſtill leſs ſuited to ſmall arms than to pieces of ordnance. The Chevalier de Follard afterwards invented another kind of chamber

chamber for cannon and mortars; this was in the form of a truncated cone, its greater diameter being towards the breech. Its advantage over the former, confifted in its allowing the inflamed powder to efcape more eafily into the caliber, whereby there was lefs fhock produced. Monf. de Marolles feems inclined to adopt this in fmall arms; but, like every other chamber whofe diameter is greater than that of the caliber, it increafes the recoil without augmenting the force of the difcharge, and has therefore been long difufed in artillery. Chambers of various other forms and dimenfions, have been fuggefted and practifed in fmall arms; but all of them lefs in diameter than the caliber, fo that the inconvenience of an excef-five recoil was thereby obviated.

Thefe contrivances feem to be founded upon a principle adopted amongft engineers, that, in the conftruction of all fire arms, the greater the diameter of the bafe at which the powder is fired, the greater will be the inflammation, upon the degree of which

depends the impulſion given to the projectile. Some gunſmiths hollow out the breech-plug in a ſpherical form, and open the touch-hole into this by perforating the breech-plug about its middle ; but as the aperture out of this chamber into the barrel, is conſiderably leſs than the diameter of the chamber, the ſtruggle of the powder in paſſing through it, will neceſſarily occaſion more or leſs agitation and recoil in the piece when fired ; beſides, as the chamber does not contain the whole of the powder, the good effects of the ſpherical form muſt be very inconſiderable. Other workmen, again, excavate the breech-plug in the form of a thimble, making the touch-hole paſs through the ſide of the plug, and enter at the very bottom of the chamber. This form is not liable to the objections ſtated againſt the ſpherical chamber. The ſituation of the touch-hole is intended to prevent the recoil which is ſuppoſed to proceed from its entering the cavity at ſome diſtance from the extremity ; but as we have already treated

this

this ſufficiently in the chapter upon the recoil of pieces, it is unneceſſary to ſay any thing farther upon it here.

Somewhat ſimilar to the laſt, but more complex, is a contrivance for which a patent has been obtained by a gunſmith of this city. It is termed a *falſe* breech, and reſembles in its conſtruction, the breech-part of the common ſcrew-barrelled piſtols. The plug-part of it, which ſcrews into the barrel, has a thimble-like chamber in it, about an inch deep and half an inch wide. From the bottom of this there is an opening, about the eighth of an inch in length, and the ſame in diameter; this leads into what is termed the anti-chamber, which is a cavity formed by the touch-hole widening in a ſugar-loaf form as it runs inwards: the anti-chamber is about a quarter of an inch in diameter, at its wideſt part. The advantages which are ſaid to ariſe from this ſtructure of the breech, are, "that the ſhot are "thrown in a more perfect direction and "with greater velocity; that the barrel is "much leſs ſubject to grow partially foul;

"that guns upon this new principle, after "being fired twenty or thirty times, loſe "very little of their force in compariſon "with thoſe of the old conſtruction;" and laſtly, "that they are ſafer, and go off more "inſtantaneouſly."

We do not doubt but the powder will generally take fire more quickly in theſe than in common barrels, owing to the touch-hole widening ſo much inwards, and the powder which lies in the anti-chamber never being bruiſed or rammed too hard, however conſiderable the force be that is employed; an inconvenience that other barrels are liable to, eſpecially in the hands of young ſportſmen, or when they are charged in a hurry. The diſadvantages inſeparable from the conſtruction of this patent breech, are, that the paſſage between the chamber and the anti-chamber, being very narrow, ſoon chokes up in the firing; and that from the anti-chamber being conſiderably wider than this paſſage, the powder contained in it does not paſs freely, when inflamed, into the caliber of the barrel, but exerts itſelf againſt

against the touch-hole, ſo as to widen it very much.

Mr. Robins obſerves, that "the ſame quantity of powder acts *rather* more violently when it fills up a long cylinder, than when it fills up a ſhorter cylinder with a larger baſe; at leaſt there ſeems to be *ſome* advantage in lengthening the chamber until its length is near three times its diameter." And the commentator on the works of Euler, whom we have had occaſion to make mention of before, in an inveſtigation of the queſtion, whether the figure of the ſpace which contains the powder may not contribute to a quicker or ſlower exploſion, ſays, "that if it does, there can be no doubt that the figure which cauſes the quickeſt is the beſt; for the quicker all the powder fires, the greater and of the longer continuance will the force which acts upon the ball be, and the quicker alſo will its motion be. And that the figure of the chamber contributes not a little to the quickneſs of firing is eaſy to be proved; for, if a very long and

narrow tube be filled with powder, and fired at one end, the fire will not extend to the other end so soon as if the tube was shorter: thus it is easy to conceive, that if the chamber of a piece consists of such a long and narrow tube, the ball will be impelled from the piece with a much less degree of velocity, than if the chamber were shorter and wider, the charge of powder continuing the same. Hence also it is easy to conceive, that the powder fires the quicker the less distance the grains lie from each other. Now since of all figures under the same circumference, the globe contains the greatest space, so that the particles or grains of powder it contains will be nearer to each other than in any space of the same magnitude; therefore there can be no doubt but the same quantity of powder will fire sooner in a globular space, than in a space of any other form: the cavity behind the ball should therefore be as nearly as possible globular; for if it could be made exactly so, the velocity of the ball would receive a considerable in-

increaſe from ſuch a figure. The effect would be ſo much the greater if the powder could be fired in the middle, ſince in this caſe the fire would extend ſooner to all the extremities. But the more the force of the powder may be increaſed in this manner, the barrel ought to be ſtronger in the part where its greateſt force is exerted." Whether or not the contrivances we have been juſt now deſcribing, were founded upon any of the hints thrown out in theſe opinions (if we ſuppoſe the gunſmiths to be ſo deeply read), we cannot pretend to ſay; but we can ſafely aſſert, that no one of the gunſmiths, with whom we converſed on the peculiar conſtruction of the breech, made and recommended by himſelf, could give any ſatisfactory or ſcientific account of the reaſons and principles on which he formed it. Upon any thing relating to fire arms, the authority of Mr. Robins is deſervedly placed in the firſt rank; but we do not think that what he has here ſaid, promiſes much advantage from lengthening the cylinder of the

the powder by means of a chamber; and the little that can be gained by it is fully counterbalanced by the disadvantages we have mentioned.

CHAP. X.

Of Rifle Barrels.

IT has been found that the flight of balls both from cannon and ſmall arms is liable to very conſiderable variations; and that the piece, notwithſtanding it was firmly fixed, and fired with the ſame weight of powder, ſometimes threw the ball to the right, ſometimes to the left, ſometimes above, and at other times below the mark. It has alſo been obſerved, that the degree of deflection increaſes in much greater proportion than the diſtance of the object fired at: thus, at double the diſtance, the deflection of the ball from the line on which the piece is pointed, is conſiderably more than double, and at treble the diſtance, more than treble what it was in the firſt. Mr. Robins ſecured a muſquet barrel upon a block of wood,

wood, and firing it with a ball, at a board of a foot ſquare, 60 yards diſtant, found that it miſſed the board only once in ſixteen ſucceſſive diſcharges; yet when fired with a ſmaller charge, at the diſtance of 760 yards, it ſometimes threw the ball 100 yards to the right, and at other times 100 to the left of the line it was pointed in. The direction upwards and downwards alſo, was found equally uncertain, the ball ſometimes bending ſo much downwards as to fall 200 yards ſhort of its range at other times. Yet the niceſt examination could not diſcover that the barrel had ſtarted in the leaſt from the poſition in which it was firſt fixed.

It is impoſſible to fit a ball ſo accurately to any plain piece, but that it will rub more againſt one ſide of the barrel than another, in its paſſage through it. Whatever ſide, therefore, it rubs againſt on its quitting the muzzle, it will acquire a whirling motion, towards that ſide, and will be found to bend the line of its flight in the ſame direction, whether it be to the right or the left, upwards, downwards, or obliquely. This deflection

deflection from a ſtraight line, ariſes from the reſiſtance which the air gives to the flight of the bullet, it being greateſt on that ſide where the whirling motion conſpires with the progreſſive one, and leaſt on that ſide where it is oppoſed to it: thus, if the ball, in its paſſage out, rubs againſt the *left* ſide of the barrel, it will whirl towards that ſide; and as the *right* ſide of the ball will therefore turn up againſt the air during its flight, the reſiſtance of the air will become greateſt on the *right* ſide, and the ball be forced away to the *left*, which was the direction it whirled in. If the axis, round which the ball whirls, preſerved its poſition during the whole of the flight, the deflection would be in the ſame direction from the one end of the track to the other. But from accidents that are unavoidable, the axis of the whirl frequently changes its poſition ſeveral times during the flight; ſo that the ball, inſtead of bending its courſe uniformly, in the ſame direction, often deſcribes a track that is variouſly contorted. So great, however, is the tendency of the

ball to deflect itſelf towards the ſide it rubs againſt, that although, when fired out of a barrel that is bent towards the *left* hand, it will be thrown from the piece in the direction of the bend, yet as the ball in this caſe will be forced to rub againſt the *right* ſide of the muzzle, and thus turn its left ſide up againſt the air; ſo it will be found to alter its courſe during the flight, and bend away towards the right hand, ſo as to fall a conſiderable way to the right of the line in which the piece was pointed.

From what has been ſaid, it will readily appear, that theſe variations will be more frequent and conſiderable when the ball runs very looſe in the piece; or when, from any roughneſs upon its ſurface, or on the inſide of the barrel, a conſiderable degree of friction takes place between them. With a view to prevent friction, it has been propoſed to greaſe the ball; but this will be of little ſervice. All that can be done in a plain barrel, is, to have the balls caſt very ſolid and true, and afterwards milled in the ſame manner as is now practiſed upon ſhot:

the

the barrel alſo ſhould be very ſmooth on the inſide, and the ball fit it very accurately, ſo as to leave ſcarcely any windage. And yet with the help of all theſe it will ſtill be very difficult to prevent it altogether, for gravity will conſtantly act, and friction on the under ſide will naturally be occaſioned by the weight of the ball.

From conſidering the cauſes of this aberration in the flight of bullets, it will be pretty evident, that the only means of correcting it is by preventing the ball from rubbing more againſt one ſide of the barrel than another in paſſing through it; and by giving to the bullet a motion, which will counteract every accidental one, and preſerve its direction by making the reſiſtance of the air upon its fore part continue the ſame in every part of the flight. The contrivance for this purpoſe is termed *rifling*, and conſiſts in forming upon the inſide of barrels, a number of furrows either in a ſtraight or ſpiral direction; into theſe the ball is moulded, and any rolling motion along the ſides of the barrel in its paſſage out, thereby prevented. Barrels of this

this conſtruction have been in uſe upon the continent ſince the middle of the 16th century, but were little known, and ſtill leſs employed, in England, until within theſe laſt 50 years. The *ſpiral* rifled barrels, however, have entirely ſuperſeded the *ſtraight* rifled ones, becauſe, although the latter prevented the rolling motion of the ball that takes place in a plain barrel, yet they do not communicate any other motion, that could ſerve to correct the variations that may occur during the flight.

The furrows, or channels, which are termed the *rifles*, vary in number according to the fancy of the workman, or that of the purchaſer, but are never leſs than ſix, or more than twelve in a common-ſized piece*. Their depth is equally ſubject to variation; but the breadth of the furrows and of the threads is generally the ſame. In ſome pieces, the ſpirals make a *half* turn, in others *three-fourths*, and in

* In the Memoirs of the Academy of Sciences at Peterſburg, ann. 1728, there is a curious tract on this ſubject, entitled, *De ſulcis cochleatis ad datam diſtantiam tubis ſclopetorum rectè inducendis.*

 others,

others, again, an *entire* revolution in the length of the barrel: an entire revolution, however, is the moſt common; though, from the great difference in the length of rifle barrels, there ſhould be ſome ſtandard aſſigned for the obliquity of the ſpiral. There is, without doubt, a certain obliquity of the ſpirals which would communicate a rotary motion to the ball, ſufficient to correct any aberration in its flight; and this might be determined by comparing the effects of a number of pieces, that differed only in the obliquity of the rifles. Barrels intended to be rifled, are previouſly bored and ſmoothed within, in the manner already deſcribed: they are, however, forged as much thicker than plain barrels as the depth of the rifles; for although the threads of the ſpiral add to the *weight* of the barrel, they do not increaſe its ſtrength in the leaſt, with regard to the force exerted upon it by the powder. As the manner in which the rifles are formed, could not be well underſtood without a plate, we ſhall not attempt to give any deſcription of it.

Theſe pieces are charged in various ways. In general, the ball, which is ſomewhat larger than the caliber before it was rifled, is driven down to the powder, by means of an iron rammer, ſtruck with a mallet, whereby that zone of the ball which is in contact with the ſides of the barrel, becomes indented all round, and is moulded to the form of the rifles. When the piece is fired, the projections of the ball which fill the rifles, being obliged to follow the ſweep of the ſpiral, the ball thereby acquires a rotary motion upon an axis that correſponds with the line of its direction; ſo that the ſide of the bullet which lay foremoſt in the barrel, continues foremoſt during the whole of the flight. By this means the reſiſtance of the air is oppoſed directly to the bullet's progreſs, and not exerted more againſt one part than another of that ſide which moves foremoſt; and accordingly the bullet preſerves the line of its direction with very great ſteadineſs.

It appears that neither the inventors of ſpiral rifle barrels, nor the perſons who firſt uſed them, were at all acquainted with the prin-

principles upon which they produced their effects. Some were of opinion, that, owing to the ball not paſſing out ſo quickly as out of a plain barrel, the powder was more completely inflamed, and thereby exerted a greater force upon it. Others, and theſe by far the greater number, thought that the ball, by combining the rotary with the progreſſive motion, did, as it were, bore the air; thereby flying much farther, and penetrating ſolid bodies to a greater depth, than when diſcharged from a plain barrel. But Robins aſſerts, that as the bullet meets with a greater reſiſtance in its paſſage through a rifled barrel, than through a plain one; ſo neither its velocity, nor the diſtance to which it is thrown, is ſo great when fired from the former, as when fired from the latter: and this difference will be very remarkable if the rifles be deep, and the ball fills them up completely; the friction, in that caſe, bearing a conſiderable proportion to the force of the powder. For the ſame reaſon, he ſays that barrels which are newly rifled, and, conſequently, ſomewhat rough

within, do not throw their balls ſo far as they will be found to do after being uſed for ſome time, and thereby rendered ſmoother; and that the miſtake of thoſe who ſuppoſed that rifle barrels threw their ball to a greater diſtance than plain barrels did, aroſe from their finding that, with the former, they could hit a mark at three or four times the diſtance they could do with a plain barrel*.

Beſides the method of loading a rifle barrel, by driving down the ball with an iron rammer, there are ſeveral others which we ſhall mention. In Germany they ſometimes charge them in the following manner: a piece of thin leather or fuſtian is cut of a circular ſhape, and ſo large as to cover a little more than one half of the ball; this

* But we have been informed by a gunſmith of eminence, that rifle barrels do throw a ball to a greater diſtance than plain ones; and indeed, from obſervations of our own lately made, we have reaſon to think this information to be the fact. This perſon further aſſured us, that rifle pieces are not ſuffered to go out of the hands of the maker until the threads were perfectly poliſhed and ſmooth. Indeed it ſeems to be obvious, that the threads of the rifle muſt be made in a very coarſe manner, to admit of improvement by repeated firing.

piece is then greaſed on one ſide, and being placed over the muzzle, the ball is laid upon it, and both thruſt down together; by this means the leather or fuſtian enters into the rifles, and the bullet being firmly embraced by it, acquires the proper rotary motion in its paſſage through the barrel. If this method be equally effectual, it is certainly much more eaſy and expeditious than that already deſcribed. Some of the old pieces of this conſtruction, were charged by taking out the breech every time; and we are informed, that the pieces uſed by the Heſſian yagers, are charged in the ſame manner as the common ſcrew-barrel piſtols. By far the moſt expeditious way of charging rifled pieces, however, is, by means of an ingenious contrivance which now generally goes under the name of Ferguſon's rifle-barrel, from its having been employed by Major Ferguſon's corps of rifle-men during the laſt American war. In theſe pieces, there is an opening on the upper part of the barrel, and cloſe to the breech, which is large enough to admit the ball. This opening is

filled by a riſing ſcrew which paſſes up from the lower ſide of the barrel, and has its threads cut with ſo little obliquity, that when ſcrewed up cloſe, a half-turn ſinks the top of it down to a level with the lower ſide of the caliber. The ball being put into the opening above, runs forward a little way; the powder is then poured in ſo as to fill up the remainder of the cavity, and a half-round turn brings the ſcrew up again, cuts off any ſuperfluous powder, and cloſes up the opening through which the ball and powder were put. The *chamber* where the charge is lodged, is without rifles, and ſomewhat wider than the reſt of the bore, ſo as to admit a ball that will not paſs out of the barrel without taking on the figure of the rifles, and acquiring the rotary motion when diſcharged. The only advantage of this contrivance, is, the eaſe and expedition with which the piece can be charged, and which are even much greater than in a plain barrel. For when the ball is forced through the rifles by the effort of the powder, the friction muſt be conſiderably

derably more than when it is moulded to them in the ramming down. It appears, however, that in whatever way the piece is charged, this friction might be much diminiſhed, by making the channels or furrows very broad in proportion to the breadth of the threads, and, inſtead of leaving the latter flat on the top, to have them terminating in a ſharp edge, whereby they would cut eaſily into the ball. This would alſo ſerve to leſſen the additional quantity of metal in the barrel, which, as the rifles are now formed, bears a very conſiderable proportion to the weight of the whole piece. The depth of the rifles, likewiſe, need not be great, as a very ſlight hold of the ball is ſufficient to communicate the deſired motion; deep rifles are particularly detrimental when the piece is charged at the breech; for if the ball be large enough to fill them up entirely, the reſiſtance, and, conſequently, the recoil, will be very great; and if it does not fill the rifles, there will be ſo much windage,

that a conſiderable portion of the flame will eſcape paſt it, and the force of the diſcharge be thereby greatly leſſened.

To render rifle-barrels as complete as poſſible, we ſhould endeavour, by every means in our power, to diminiſh the friction between the bullet and the ſides of the barrel. We have already mentioned ſome alterations which we think would conduce to this. The turns of the ſpiral being exactly parallel to each other, and both the threads and the furrows being made perfectly ſmooth, are circumſtances abſolutely eſſential to perfection; as thereby the bullet, when once put in motion, will paſs through the barrel with very little friction. The moſt accurate method of aſcertaining this, is, by pouring melted lead into the barrel ſo as to form a cylinder of two or three inches in length, and which is exactly fitted to one portion of the caliber: if this cylinder, when moved a little, paſſes without ſtop or difficulty from one end of the barrel to the other, by being puſhed

gently,

gently, the rifling may be pronounced very exact. The ſame thing may be tried with a plug or ball of lead, driven into one end of the barrel ſo as to fill the rifles, and puſhed forward with the ramrod.

From the imperfect manner in which any inſtrument works in a ſpiral direction within the barrel, the furrows are generally left very rough; and hence rifled pieces are found to throw their ball to a greater diſtance, though with equal accuracy, after being uſed for ſome time, and thereby having the bottom of the furrows, and edges of the threads, worn ſmooth. We think that theſe might be rendered ſmooth at firſt, by means of a plug of lead or pewter made to fit the rifles, being fixed to an iron rod, and wrought backwards and forwards in the barrel, with fine emery and oil: or the leaden plug might be employed as a pattern to form one of braſs or ſteel by, for the ſame purpoſe.

As the pieces which are charged at the

breech, are confiderably dearer than the others, and, excepting the expedition with which they can be charged, are really inferior to thofe charged at the muzzle; we are of opinion, that the latter might, by a very fimple means, be rendered equally ferviceable with the former. This is nothing more than having the balls caft with projections that anfwer to the rifles; which may be done with great eafe and accuracy by making correfponding hollows round a zone of the bullet-mould: by this the ball may be fitted fo accurately to the rifles, as to leave fcarcely any windage; whilft the friction will be lefs than it is either when the ball is put in at the breech, or forced in by the muzzle.

The only other improvement which this matter feems to admit of, is, that of making the balls in the form of an egg; as thefe, from having their centre of gravity nearer to the great end than to the fmall one, will, when fired with the larger end foremoft, preferve their courfe much more

ſteadily than thoſe of a ſpherical figure. Bullets of this ſhape may be uſed either in plain or in rifled barrels*.

In treating of the cauſes of aberration in the flight of balls, we have ſuppoſed the air to be perfectly ſtill; it being evident, that the force of the wind will affect balls conſiderably, whether they are fired from a plain, or from a rifled barrel; but, for the reaſons already given, will affect the former in a much greater degree than the latter.

Pieces intended for ſhooting with ball, whether they be plain or rifled, ought to be of much more equal thickneſs from the breech to the muzzle, than thoſe that are intended for ſhot only. In every barrel, there is an undulating vibration communicated to the metal by the exploſion. This is moſt remarkable in a *thin* barrel, and

* Our experiments, however, lately made to aſcertain this fact, have turned out contrary to our expectation; for we found that the oblong balls did not retain their rectilinear direction, but on the contrary whirled round.

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when the charge is great; and may be rendered very evident by the following eafy experiment. Take a piece of fine fteel or iron wire, that is tempered fo as not to ftretch readily; pafs it once round the thin part of the barrel, and twift it tight. The piece being then charged and fired, the wire will be found burft afunder, or confiderably untwifted. It is evident, that fuch a degree of vibration in the barrel, muft have an effect upon the ball in its paffage through it; and that the only means of preventing it, is, by having an additional quantity of metal in the barrel, and efpecially in the fore part of it. The fame circumftance certainly obtains, though in a much lefs degree, in fowling pieces; and on this account, as well as on that of the recoil, a barrel which is ftrong enough to withftand any charge that is required, may yet have too fmall a quantity of metal in it.

Having now fully explained the principles upon which rifle barrels produce their

their effects, our readers will be prepared to consider how far the *straight* rifling can be useful when employed for shot. These pieces are said to be very common in Germany, and are used by a few persons in this country; though we understand that the greater number even of these few are now less partial to them than they were at first. If the divergency of shot arises from the same cause as that of ball, viz. from acquiring a whirling motion to one side or other by rubbing against the sides of the piece, it is evident that rifling the barrel can have no tendency to prevent this. For let it be granted, that the channels or flutings within are semicircular, and that the shot is exactly adapted to these (two circumstances said to be necessary to the perfection of these pieces), it cannot be imagined that the grains will acquire less of the rolling motion in passing along these flutings, than in passing along the sides of a plain barrel; on the contrary, it will necessarily be greater, as the points of contact are considerably more numerous.

It

It may not be improper to mention, that the ſame wonderful powers and effects were aſcribed to this conſtruction of the barrel, as invariably are to all the improvements—or rather alterations (however trivial)—either made or adopted by the gunſmiths in this age of whim; the aſſertion always is the ſame, that the piece is thereby not only to carry its ſhot much cloſer, but to ſhoot much farther. To the honour of the diſcerning part of the ſportſmen of the preſent age, thoſe novelties and fancied improvements have but their day.

CHAP. XI.

Of the Stock, Lock, &c.

UPON the other parts of the fowling piece, there is little required to be ſaid, as they are varied according to the fancy of the workman, or the whim of the purchaſer, without any material advantage or detriment to the piece.

The wood which is moſt commonly employed for the ſtock, and which appears the beſt for the purpoſe, is walnut; and the only choice in this, is, that the grain be even and cloſe, and as free as poſſible from knots and burrs, which, though they may add to the beauty of the ſtock, ſeldom fail to take away from its ſtrength, unleſs they are confined entirely to the butt part. As to the curvature, no particular degree can be aſſigned as a ſtandard; different

different persons requiring different degrees, according to the length of their neck, and to the manner in which they hold their head whilst taking aim. This, therefore, as well as the *length* of the butt, which depends partly upon the circumstances just mentioned, but chiefly upon the length of the arms, can be determined with great accuracy by the gunsmith, from observing the manner in which the shooter presents his piece and takes his aim.

With regard to the locks, we have nothing material to offer; the genius and industry of the English workmen having already brought them to such a degree of elegance and perfection, that we have scarcely any thing farther to hope for, or require. The real improvements are not confined to any particular maker; and though the minutiæ peculiar to each, may determine the purchaser in his preference, no person need fear much disappointment in the essential qualities of a lock, provided he goes to the price of a good one.

It

It is of much more consequence to the excellence of a lock, that the ſprings be proportioned to each other, than that they ſhould all be made very ſtrong. A moderate degree of force is ſufficient to produce the required effect, and whatever exceeds this, proves detrimental, by rendering the trigger difficult to draw, or producing ſuch a ſtroke as breaks the flints, or throws the piece from the direction in which it was pointed. If the main-ſpring be very ſtrong, and the hammer-ſpring weak, the cock is often broken for want of ſufficient reſiſtance to its ſtroke, until it is ſtopped all at once by the cheek of the lock-plate. Whilſt, on the other hand, if the hammer-ſpring be ſtiff, and the main-ſpring weak, the cock has not ſufficient force to drive back the hammer. And, in both caſes, the colliſion between the flint and ſteel is too ſlight to produce the neceſſary fire. The face of the hammer, alſo, may be too hard or too ſoft. The former is known by the flint making ſcarcely any impreſſion upon it, and the

ſparks being few and very ſmall. The latter is known by the flint cutting deep into the hammer at every ſtroke, whilſt the ſparks are alſo few in number, and of a dull red colour. When the ſtrength of the ſprings, and the temper of the hammer, are in their due degree, the ſparks are numerous, brilliant, and accompanied with a conſiderable whizzing noiſe.

To explain theſe differences it is neceſſary to obſerve, that the ſparks produced by the colliſion of flint and ſteel are particles of the metal driven off in a ſtrongly-heated ſtate, and which falling among the powder inflame it inſtantly. By ſnapping a gun or piſtol over a ſheet of white paper, we may collect theſe ſparks, and, by ſubmitting them to a microſcope, demonſtrate the truth of this. If the ſparks are very brilliant, and accompanied with a whizzing noiſe, we ſhall find the particles collected on the paper, to be little globules of ſteel, which were not only melted, but have actually undergone a conſiderable degree of vitrification from the intenſity

of the heat excited by the collifion, their furface exactly refembling the flag thrown out from an iron foundery. When the face of the hammer is too hard, the particles which the flint ftrikes off, are fo fmall, that they are cooled before they fall into the pan; and when the hammer is too foft, the particles driven off are fo large as not to be fufficiently heated to fire the powder.

We think the conical form of the touch-hole a real improvement; but do not approve of its widening fo much as it does in the patent breech, as the force of the fufe againft the opening into the pan, is greatly increafed by it.

Gold pans are of very little advantage; for as the iron muft be foftened before they can be applied, it is very liable to ruft, and thus deftroy its connection with the gold; the tin, alfo, by means of which the gold lining is fixed, is frequently melted by the fire of the fufe being directed upon the bottom of the pan, and the gold thereby detached from its hold; this will happen more readily when the touch-hole is placed

very low, and when, from its form or width, the fire of the fuſe is conſiderable. A great improvement, however, has lately been made in the manner of putting in the gold pans; they are now "DOVETAILED" in, before the lock-plate is hardened, by which means they ſeldom or ever "BLOW" out; and it is now found that they will ſtand better than any other ſpecies of pan, provided that the lock is eaſed from the touch-hole, or taken off when the barrel is taken out of the ſtock. Still we are of opinion that the ſteel pan will be found, with common care in cleaning it, to laſt as long, and to anſwer every purpoſe as well, as when lined with gold.

ESSAY

ON

SHOOTING.

PART II.

Come then, ye hardy youths, who wiſh to ſave
By generous labour powers that nature gave;
Glad on the upland brow, or echoing vale,
To drink new vigour from the morning gale;—
Come! and the muſe ſhall ſhew you how to foil
By ſports of ſkill the tedious hours of toil;
The healthful leſſons of the field impart,
And careful teach the rudiments of art.

SHOOTING, a *Poem*, by H. I. PYE, Po. Laur.

C H A P. XII.

...arks on the Properties and Action of Gun-...wder, and Inſtructions for the Choice of Gunpowder, Shot, Wadding, &c.

ALTHOUGH we muſt admit, that dexterity in ſhooting is the main ...nt in the ſucceſs of the chace; that prac-...e alone acquires it; and, that it is poſſeſſed ...y ſportſmen in different degrees, according ...the aptitude which nature has beſtowed ...n them for the amuſement; ſtill, it is no ...s true, that, in order to obtain complete ...ucceſs, this dexterity ſhould be aſſiſted by ...veral acceſſary means, and by certain pre-...utions and attentions, which ought on no ...count to be neglected. Theſe we ſhall ...ndeavour to lay down, and therefore pro-...eed to give ſome inſtructions on the arti-...cles of *powder*, *ſhot*, and *wadding*, the prin-...cipal agents of the ſport.

POWDER.

THE various kinds of powder uſed in England are ſo well known, that they need not be enumerated here. Our experience formerly induced us to recommend Hervey's battle powder, as being, at that time, ſuperior to every other we had met with. The candour and juſtice, however, that are due to the merits of individuals, and to thoſe improvements that are from time to time made in the arts, combined with our individual wiſh to give every kind of uſeful information to the ſportſman, compel us to ſay, that we can now again, and with the greateſt confidence that can be ſuppoſed to reſult, as well from ſubſequent experience of our own, as from the corroborating teſtimony and approbation of others, recommend the Dartford powder of Meſſ. Pigou and Andrews, for being, not only ſtronger, but the cleaneſt in burning and the quickeſt in firing, of any other at this time manufactured in the kingdom; and we alſo venture

ture to give it as our opinion, that the manufacturers of this powder ſeem to have attained, as nearly as any purpoſe can require, that accuracy of granulation, and of the proportions and qualities of all the ingredients, which moſt readily produces the deſtruction of all the compoſition, and yields the greateſt poſſible quantity of the permanent elaſtic fluid in a given time, which properties alone can conſtitute powder of the beſt quality.

The excellence of this article as to its properties, and the relative condition in which it is at the time of uſing it, with reſpect to dryneſs, dampneſs, or age, are in themſelves circumſtances ſo obviouſly important to the ſportſman, that we have often been aſtoniſhed at the almoſt total neglect which attends this part of the ſhooting ſcience: but he may henceforward be aſſured, that, without the utmoſt circumſpection and care herein, his high-priced fowling piece will but little avail him; mortification and diſguſt will generally enſue, and the gunſmith too frequently be blamed for the

fault

fault which the ſportſman alone has created by his own neglect.

Let us endeavour to render the defect in point of attention to this moſt principal article of the ſportſman's panoply, leſs prevalent in future.

To this end, a plain and conciſe deſcription of the compoſition and properties of gunpowder will not, we hope, be incompatible with the preſent work.

The *making* of powder requires a conſiderable knowledge of chemiſtry; and to enquire into the amazing force of gunpowder, we muſt take natural philoſophy to our aſſiſtance. To treat, therefore, of the force of gunpowder in its full extent, requires ſo much knowledge in the higher branches of mathematics and mechanics, that we may fairly aſcribe to this reaſon, the few treatiſes that have been written on the ſubject.

As the moſt learned work, however, that we have yet met with on this topic, we may ſafely mention the Treatiſe of Monſ. d'Antoni, who is the chief director of the Royal Military Academy at Turin. The following obſer-

obſervations are extracted from the elegant tranſlation of the above work, by Captain Thompſon of the Royal Artillery; and we are induced to do this from the perſuaſion, that they comprehend every thing that the ſportſman has occaſion to know for the purpoſe of inculcating the attention and knowledge already ſo ſtrongly recommended; and to this tranſlation we beg to refer ſuch of our readers as wiſh for the moſt complete and extenſive information on the properties of powder, and the ſcience of gunnery in general.

Gunpowder is compoſed of very light charcoal, ſulphur, and well refined ſaltpetre. The powder uſed by ſportſmen in ſhooting game, is generally compoſed of ſix parts of ſaltpetre, one of charcoal, and one of ſulphur; but theſe proportions, as well as the introduction of other ingredients, and the ſizes of the grains, are undoubtedly varied by the different manufacturers in the compoſition of the powders of the ſame denomination, and are always kept profoundly ſecret.

Theſe

Theſe materials are put into a wooden trough, where they are ground together, to render the contact of the nitrous and combuſtible particles intimate and equal throughout the whole maſs. The mixture is occaſionally ſprinkled with water, to form an amalgam, which is afterwards granulated, and to prevent the finer particles of the ſulphur and the charcoal from flying off, which would neceſſarily alter the proportion of the compoſition. The powder makers employ more or leſs time in the operation of grinding, in proportion to the quantity and quality of the ſaltpetre. When they conceive that the ingredients are properly mixed together, they form from the paſte thoſe little grains which, being dried, obtain the name of gunpowder. The coal uſed in the making of this ſort of powder is either of willow, hazel, or dogwood, well charred in the uſual manner, and reduced to a fine powder.

In the firſt years that ſucceeded to the diſcovery of gunpowder in Europe, the proportion of the conſtituent parts, and the

ſize

ſize of the grains, varied very much, which gave riſe to the ſeveral denominations it has obtained. At the beginning of this century theſe proportions and ſizes were almoſt every where reduced to three; and at preſent, throughout all Europe, only one kind is uſed for military purpoſes.

The properties and effects of gunpowder can only be aſcertained by the means of fire: it is neceſſary, therefore, in the firſt place, to examine the nature of fire itſelf, according to the doctrine of thoſe philoſophers, who, by the cloſeſt inveſtigation of its effects, have endeavoured to explore its principles and cauſes.

The celebrated Herman Boerhaave, whoſe opinions have been adopted by the moſt eminent chemiſts, could only, after a long ſeries of experiments, diſcover a few of the properties from which fire has derived its ſeveral denominations, according to the various modifications under which it preſents itſelf to our ſenſes.

Pure fire is called fire, ſolar matter, light and heat: under this idea it is conceived to

be a ſubſtance eſſentially fluid, compoſed of particles very ſubtle, and continually agitated, though not always in the ſame degree. The learned Beccari has proved that it exiſts in all places, and in almoſt all bodies, without being able to decide whether it be a conſtituent and eſſential principle. A gentle friction of a globe of glaſs in the electric machine, ſhews that every thing partakes of it; and two hard bodies rubbed violently together gradually grow warm, and at length emit ſparks and flame according to their ſeveral qualities.

Fire which ſeems to paſs from a fluid to a ſolid ſtate, and become a part of the body, as the inflammation of ſome bodies evidently ſhews, is called combuſtible matter, ſulphur, the food of fire, and phlogiſton.

One of the diſtinct characters of fire, conſidered as ſolar matter, light, &c. is to eaſily penetrate bodies by inſinuating itſelf into them equally, and expanding them ſo as to cauſe a disjunction of the component parts when introduced in quantity. But the facility with which fire effects this is

dif-

different, according to the qualities of the bodies it enters; there are even ſome which, far from being dilated by the action of fire, are contracted, as wood, animal bodies, &c.

Another character of fire is, to render ſubſtances luminous, either by means of the flame which breaks from them, or by their becoming red. Fire conſidered as combuſtible matter, ſulphur, phlogiſton, &c. cauſes no change in the body in which it reſides, nor does it communicate to it either light or heat, unleſs it paſs from a quieſcent ſtate to ignited motion, or inflammation.

The different effects of the firſt ſpecies of fire may be conſidered under three heads:

In a determined ſpace.

As actually exiſting in a body. And

With regard to the manner and law in which it enters and expands bodies of different natures.

Conſidering fire in a determined ſpace, we find that, as its quantity and velocity may vary, ſo alſo in the ſame proportion will its activity and efficacy be different; as may be obſerved in burning glaſſes, reflecting

telefcopes,

telescopes, &c. The activity and efficacy of fire can only be ascertained by the expansion of bodies, and the disjunction of their parts: but hitherto the method of measuring exactly not only the quantity and velocity of fire separately, but even its absolute effects on bodies are unknown. The point to which a body entirely deprived of fire can be condensed, is equally undetermined with the first instant of its expansion. The condensation of mercury, produced by a certain quantity of sal-ammoniac and snow mixed together, is, in the construction of thermometers, the lowest point that we know; while that, from experiments made in more northern climates, it is clear that mercury can be much more condensed. In the construction of pyrometers, the point of the greatest condensation depends on the variable temperature of the atmosphere. Thus these two instruments serve only to shew, by their graduation, the difference of expansion, according to the degree of fire that they contain or are penetrated with.

The activity of fire considered as actually existing

existing in a body, depends, not only on the quantity and velocity of the ignited matter, but also on the mass of the body in which it exists. On attempting to reduce two fluids of unequal density to the same temperature, the most dense requires the greatest degree of heat: thus, when the activity and degree of fire which the two bodies contain, are proportional to their respective masses, they are equally hot. On touching two bodies of unequal density, reduced to the same temperature, the most dense appears the hottest; because the hand being in contact with a greater number of particles in the denser body, the sensation excited is proportionally stronger.

The manner and law under which fire penetrates bodies, is modified by the degree of its activity, the time of application, and the superficies, quality, and mass, of the surrounding bodies; for, should any one of these circumstances vary, a different modification will result. Thus, put into the same fire two pieces of iron of the same quality, but of different sizes, the smaller piece will

become hot much ſooner than the larger one; and if the ſurface of the larger piece be increaſed by flattening it with a hammer, it will become hot in leſs time. This diverſity of effects may be equally remarked on comparing a piece of iron with a ſtone or any other body, put into the ſame fire. Theſe obſervations on the facility with which fire inſinuates itſelf into bodies, are equally applicable to the facility with which it quits them, and diverges from its focus: for when the quantity of fire in any body is greater than in the atmoſphere or other ſurrounding bodies, it quits that body, and removes from it, ſpreading itſelf equally on all ſides; its activity diminiſhes in proportion to its diſtance from the body which it quitted, and its extenſion depends on its exceſs over the external fire, on the time of application, the ſuperficies, quality, and maſs, of the ſurrounding bodies.

Having thus examined the various circumſtances that tend to modify the effects of fire, let us now conſider theſe modifications with reſpect to the ignition and deſtruc-

tion of combuſtible bodies. Whether the ignited motion excited in a combuſtible body appears under the form of flame, or burning coal, it is always produced in two manners; either by applying to the combuſtible body a quantity of external fire, or by increaſing the motion of the fire that exiſts in it.

From the facility with which combuſtible bodies take fire, they may be ranged in two claſſes. In the firſt may be placed ſpirits of wine rectified, ſulphur, &c. in which, by applying fire to any one part, it is communicated to the whole maſs, ſo as to produce a total deſtruction. In the ſecond claſs may be ranked coal, the greater part of vegetables, &c. in which fire can be propagated only by a continued application, by increaſing the motion in the ignited parts, or by placing the bodies in ſuch a manner, that the fire, in eſcaping from the burning particles, may meet almoſt inſtantaneouſly thoſe not yet ignited.

The degree of ignition varies according to the different qualities of the bodies themſelves; for a greater degree of fire is requi-

ſite in proportion to the rarefaction of the ſurrounding air, or to the difficulty of removing from the ignited body ſmoke or other ſubſtances, which do not ſerve as food to fire. In both theſe caſes it is neceſſary either continually to apply freſh fire, or to increaſe the motion of that which already exiſts in the body.

From theſe premiſes it may be inferred, that fire admits of infinite diverſity in its effects, ariſing not only from the time of application, the ſuperficies, quality, and maſs of the bodies to which it is applied, and which ſurround it, but even from the modifications that enſue from the quantity and velocity of the ignited matter. Wherefore the force of gunpowder fired in muſquets, cannon, mortars, mines, &c. being in proportion to its inflammation, its effects muſt inevitably be modified by the quantity and the proportion of the ingredients, the temperature of the atmoſphere, and other circumſtances that will be hereafter pointed out. And ſince it is not in our power to determine every point that affects its inflammation

flammation and total consumption, we cannot be always certain of producing the same effects with the same quantity of powder fired from the same piece of ordnance.

Sulphur is a substance composed of vitriolic acid and a combustible matter. It is ranked in the class of minerals, because it is extracted from the bowels of the earth. When exposed to a moderate degree of heat, it liquefies, and sublimes in little tufts called flowers of sulphur: thus it is purified from heterogeneous substances by sublimation.

The property of sulphur is to take fire, inflame, and be entirely consumed, when exposed in the open air to a stronger fire than that which will liquefy it. It is made use of in the composition of gunpowder, because the ignited motion is easily propagated in it.

The facility with which sulphur takes fire and burns, depends on the rarefaction of the surrounding air. To burn it in an exhausted receiver, it requires a continued application of a much greater degree of heat than would inflame it in the open air:

the receiver ſhould alſo be of a ſize proportioned to the quantity of ſulphur, leſt the condenſation of the ſmoke prevent its total conſumption. The only method of decompoſing ſulphur, is by burning; which deſtroys the combuſtible matter, and the vitriolic acid exhales in vapour.

Charcoal uſed in the compoſition of gunpowder, is defined to be a body compoſed of a combuſtible matter, and of the denſe earthy particles contained in vegetables. In making charcoal, the vegetables are burned in ſuch a manner, that they do not inflame; and then the combuſtible matter unites itſelf intimately with the moſt denſe earthy particles. Charcoal can only be decompoſed by fire, which, at the beginning of the ignition, ſeparates the combuſtible matter from the earthy particles, which are then termed cinders.

When charcoal is expoſed in the open air to a ſufficient degree of fire, its property is to burn and be conſumed. It ſometimes emits a little blue flame; but more frequently ſparkles, and becomes red without emitting any

any flame. If in this ſtate it be agitated by the wind, it appears of a more lively and brilliant red in proportion to the force of the wind, and is ſooner reduced to cinders. From this property it enters into the compoſition of gunpowder.

Generally ſpeaking, charcoal appears red only when a greater degree of fire is applied to it than will burn ſulphur; the propagation of the ignited motion, and its total conſumption, are effected more ſlowly than in ſulphur. Theſe effects differ according to the quality of the charcoal: that which is the lighteſt, or which contains leaſt of the denſe earthy particles, takes fire and is conſumed the quickeſt.

The more the air is rarefied the more difficultly charcoal burns, and the greater degree of fire is requiſite to keep it red-hot.

Saltpetre is formed from a combination of the nitrous acid with a fixed alkali. It is extracted principally from animal and vegetable ſubſtances, found in a putreſcent ſtate, mixed with ſtones, earths, and plaiſters, and is ſeparated from them by boiling them

in a water impregnated with a ſixed alkali. The ſalt cryſtallizes in long filaments, lying one upon another. This is the only method of purifying it; and muſt be repeated two or three times, according to the quantity of the heterogeneous matters. When by this proceſs the ſaltpetre has been well purified, it has always the ſame properties, from whatſoever ſubſtances it may have been extracted.

Its properties are, to diſſolve in water, more fully in boiling than in cold water; and to liquefy, by a greater degree of heat than is required to liquefy ſulphur. If the heat be increaſed while the ſaltpetre is in fuſion, it ſublimes in viſible particles; which, collecting together on the upper part of the veſſel, are called flowers of nitre. To ſeparate the acid from the alkali, without putting the ſaltpetre in contact with a combuſtible body, it is neceſſary to expoſe it a long time to a very ſtrong fire; and even then the decompoſition is brought about very ſlowly.

If a combuſtible body containing a ſufficient

ficient degree of heat, touch ſaltpetre, a very fierce flame is excited at the point of contact, accompanied with detonation, and a wind which increaſes the activity of the fire. In this operation the acid is ſeparated from the alkali, and diſſipated. The combuſtible body is inſtantly conſumed, and the alkaline reſiduum is termed decompoſed, or fixed nitre.

This decompoſition of ſaltpetre takes place equally in the open air and in vacuo; provided that, in vacuo, the action of the fire be ſufficient to keep the combuſtible body in a ſtate of ignition. Saltpetre may be decompoſed by fire in two ways: by coming in contact with an ignited combuſtible body when in a ſolid ſtate; or by communicating, when in fuſion, the ignited motion to a combuſtible body in contact with it.

In the firſt caſe, by applying burning charcoal, the decompoſition begins and continues till the ſaltpetre or the charcoal be entirely conſumed. To effect the deſtruction of both at the ſame time, the quantity of charcoal muſt be proportioned to the

quantity

quantity of ſaltpetre. The better the ſubſtances are mixed together, the more immediate will be the contact between the ſeveral parts, and the ſooner will both be conſumed.

Burning ſulphur not being able of itſelf to decompoſe ſaltpetre, charcoal is added to it. Now charcoal of every kind burns when expoſed a ſufficient time to the action of burning ſulphur; yet this takes place ſooner or later in proportion to the denſity of the charcoal, or to the quantity of denſe earthy particles; wherefore, that the fire produced from the ſulphur may be ſufficient to burn all the charcoal, the quantity of each muſt be exactly proportioned, and attention paid, at the ſame time, to the quality of the charcoal.

When this proportion is determined, a quantity of ſaltpetre added, and the three ſubſtances well ground together, in order to render the inflammation more inſtantaneous, even then the effects vary; for if the ſaltpetre be in too great a quantity, the combuſtible particles being too far ſeparated, the fire applied to one part will not be able to

ſpread

ſpread to the others; or the combuſtible particles, being in too ſmall a quantity, will be conſumed long before the ſaltpetre. If, on the contrary, the ſaltpetre be in too ſmall a quantity, it will be conſumed before the other two ingredients; wherefore, that the deſtruction of the three may begin and end at the ſame time, they muſt be mixed in a juſt proportion. As ſoon as the ſaltpetre begins to be decompoſed, the wind generated from it renders the heat of the charcoal more intenſe, increaſes the activity of the fire, and accelerates the total deſtruction of the whole.

This decompoſition of ſaltpetre, by the application of charcoal and ſulphur, is ſimilar to the proceſs that takes place when powder is burned in the open air, or in fire arms.

There ſeems to be nothing in the fabric of gunpowder, that can alter any of the properties of the conſtituent parts, taken either individually or collectively. The neceſſity of having a combuſtible body capable of producing the total and inſtantaneous decompoſition of the nitre, makes ſulphur and charcoal requiſite ingredients: ſulphur,

ſulphur, becauſe it eaſily takes ſire and propagates the inflammation, though the heat it produces is not ſufficient to decompoſe the nitre: charcoal, becauſe its inflammation, as well as the propagation of fire into all its parts, being ſlower, it acquires, when it becomes red-hot, a ſtronger degree of heat than the ſulphur, and is therefore more capable of producing the entire decompoſition of the nitre. Therefore, from their combination with a proper proportion of nitre, the moſt inſtantaneous exploſion may be expected; but if the quantity of nitre be too great, the fire, communicating to the combuſtible particles with ſo much the more difficulty as the exceſs is the greater, may produce no effects. If to a compoſition of fourteen parts of ſaltpetre, one of ſulphur, and one of charcoal, a burning coal be applied, thoſe parts only of the mixture in contact with the coal will burn, the flame not being able to communicate itſelf to the other parts. If, on the contrary, the nitre be in too ſmall a quantity, on applying fire to one part, the flame which breaks out at its decompoſition is too weak to ſpread itſelf

to

to the others, owing to the great diſtance of the nitrous particles: the deſtruction of the whole, therefore, requires a much longer time; and the quantity of permanent elaſtic fluid, on which depends the greateſt force of the powder, is leſs; as may be proved by burning a mixture of equal parts of ſulphur, charcoal, and ſaltpetre.

We will now proceed to prove, that fired powder preſerves conſtantly the properties remarked in the combination of its ingredients, modified nevertheleſs by the exactneſs of the mixture, the ſize of the grains, and other circumſtances that will be pointed out. All degrees of heat are not ſufficient to fire powder; for if it be only *ſufficient to* inflame ſulphur, the effects before mentioned will reſult, as may be proved by throwing ſeveral grains of powder near hot coals. The burning of the grains contiguous to the coals will be ſo inſtantaneous, as not to be diſtinguiſhable from the inflammation of the ſulphur; but the grains at a little diſtance from the coals will emit, after ſome time, a ſmall, blue, lambent flame, which at length

length becomes brighter ; the intenseness of the fire increases, and the gradual destruction of the saltpetre is clearly discernible; some of the grains are consumed, while in others the blue flame disappears without producing their destruction : at length the more distant grains become warm, without emitting any flame or being consumed. This may be exemplified by putting some large grains of powder on an iron plate, which may be put near to, or drawn back from the fire, in order to give it different degrees of heat; or by directing upon them the solar rays, united by means of a convex glass, as different degrees of heat may be produced by augmenting or diminishing the circle formed by the re-union of the rays.

These experiments prove that powder, like other combustible bodies, may become hot or inflamed, without being in the same instant consumed. It is necessary, therefore, to distinguish between the inflammation and the final destruction of each grain: for fire, when applied to two grains of different

ferent ſizes, does not always cauſe any ſenſible difference in their deſtruction; yet there is a great difference in the force of two equal quantities of powder, made with the ſame proportion of ingredients, of the ſame quality, but differently granulated, as is ſeen on comparing cannon and muſquet powder.

Having aſcertained thoſe two properties, it remains to demonſtrate, that when fire is applied to grains of powder, the inflammation of the contiguous grains, and the deſtruction of each individual grain, takes place progreſſively; and that the velocity with which fire ſpreads itſelf on all ſides to inflame the contiguous grains, is greater than that with which it penetrates into the ſubſtance of each grain. It is too obvious to need inſiſting on, that all motion, however rapid or ſhort it may be, takes up a certain time; though to us, from the ſhortneſs of its duration, it appears inſtantaneous: conſequently, the inflammation and entire deſtruction of powder, produced by the action of fire, communicating itſelf to every thing around,

around, like rays from a centre, muſt neceſſarily take place in a determined ſpace of time; which varies according to the ſtrength of the fire, the proportion of the ingredients, the nicety of the mixture, and the ſize of the grains.

When a ſufficient degree of fire is applied to one grain of powder, it firſt acts upon the ſurface, and then penetrates towards the centre. As the ſurface burns, a flame is excited, which catches the neareſt grains, if the degree of heat be ſufficient, and the ſurrounding air not too much rarefied. In the mean time, the fire which attacked the firſt grain, continues its action towards the centre till it be totally conſumed.

There are then two diſtinct actions in the inflammation and the total conſumption of powder: the firſt is the expanſion of the inflamed fluid; which ſpreading itſelf from the ſurface of the burning grains, ſurrounds the contiguous ones: the ſecond is the penetration of the fire from the ſurface of each grain towards its centre. But the flame always ſpreads with more rapidity between the

the intervals of the other grains, than it penetrates towards the centre of each grain.

The following obſervation will prove that a determined time is requiſite for the conſumption of each grain. Make of the common mixture, ſome grains of powder as large as piſtol bullets; dry, and ſet fire to them: it will then be ſeen that the fire penetrates from the ſurface to the centre, in a longer or a ſhorter ſpace of time according to the ſize of the grains; ſo that if there be no other difference between theſe large grains and common ones than in ſize, it may be inferred, from analogy, that the ſmalleſt muſt require a certain ſpace of time, however ſhort. It is likewiſe clear, that the flame, in ſpreading itſelf from the burning grains to the contiguous ones, takes up a certain ſpace of time; as may be exemplified by ſetting fire to a train of powder. But it is not ſufficient to have proved that the burning of each grain, and the inflammation of the contiguous ones, are progreſſive; it is neceſſary further to ſhew, that the activity

with which fire ſpreads itſelf between the interſtices of the grains, is greater than that with which it penetrates from the ſurface toward the centre of each grain. If we conſider that the inflamed fluid, in paſſing between the grains, meets no other reſiſtance than the common air, which is eaſily penetrated, by reaſon of its rarefaction; and that the fire, in inſinuating itſelf from the ſurface toward the centre of the grain, muſt paſs through a ſubſtance much more denſe; it is evident that, the reſiſtance in the ſecond caſe being greater than in the firſt, the fire muſt conſequently be ſlower in its progreſs.

The following experiment will ſerve in proof of this aſſertion. Let a piſtol barrel, with the vent cloſed up, be filled with powder to the muzzle: on applying fire to it, the barrel will inſtantly empty itſelf, with an exploſion. Let it be again filled with powder well compreſſed, ſo that the interſtices between the grains may be as ſmall as poſſible, and form, as it were, a ſolid body;

body; the time that the barrel will take to empty itſelf will be ſenſibly longer than before.

The great velocity with which the inflamed fluid paſſes from the muzzle to the breech of the piſtol barrel, between the interſtices of the grains, is obſervable in the firſt experiment; and in the ſecond, it is ſeen how much this velocity, from the neceſſity of penetrating the powder itſelf, is retarded.

From the three preceding paragraphs, the following principles are deducible.

That in burning two equal quantities of powder, made of the ſame compoſition, but differently granulated, as cannon and muſket powder, the latter will be conſumed in leſs time than the former; becauſe the grains being ſmaller preſent to the fire a greater ſuperficies, and produce, at the firſt inſtant, the inflammation of a greater quantity of matter; which is conſumed ſo much the ſooner, as the fire has leſs ſpace to paſs through from the ſurface to the centre of each grain. That this depends not only

upon the ſize of the grains, but alſo upon the facility with which the fire paſſes between them. On the other hand, the grains ſhould not be too ſmall; for then the interſtices will be ſo diminiſhed, as to admit the flame to paſs with difficulty; and they will be ſo compact, as to form, as it were, a ſolid body.

The grains of powder are generally of a very irregular form and uneven ſurface; whence ariſe many varieties in the quickneſs of its inflammation and exploſion. To remedy theſe inconveniences, ſome manufacturers put the powder into a barrel ſuſpended by two pivots; and having turned it for ſome time, ſeparate, by means of a ſcreen, the duſt from the grains, which are, by this operation, ſufficiently ſmoothed and rounded. On comparing powder made in this manner, with powder of an irregular form and uneven ſurface, the latter is found to take fire more quickly, though the proportion of ingredients be preciſely the ſame in both. Nevertheleſs, as the interſtices between the round grains are larger than between grains of an irregular figure, and as upon them the

quickneſs of the inflammation greatly depends, the round grains may be ſo ſmall, that the interſtices being equal in both, the fire may be able to ſpread itſelf equally, and conſume the powder with the ſame rapidity; and as powder of an irregular grain takes fire more eaſily than ſmooth-grained powder, a proportional ſize might be fixed on which would cauſe the latter to inflame with greater, or at leaſt equal promptitude.

As theſe properties are common to all kinds of powder that are well made, of proper materials, and equally dried, varieties in their effects can only reſult from the different proportion of the ingredients, the ſize of the grains, their figure, and ſmooth or uneven ſurface. If the ingredients, however good in quality, are not well mixed together, the powder will not ſo readily burn, and the difference of the effects will be very ſenſible.

The common air that is within and between the grains contributes likewiſe, by its expanſion, to the force of the powder

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when fired. Its abſolute force might be eaſily determined; but is very ſmall, in compariſon of the elaſticity of the permanent fluid generated from powder. Some, however, pretend to have aſcertained, that in ſix grains of powder there is at leaſt one grain of pure air in a very compreſſed ſtate.

Thus the diminution of the ranges of fire arms, when heated by frequent diſcharges, or when the air of the atmoſphere is more rarefied, ought not to be attributed to leſs elaſticity in the air, but rather to the ſecond property of powder; where, being fired in a rarer medium, leſs takes fire, though the ſame quantity be uſed; and hence the range is ſhortened, as may be clearly proved by various experiments.

For the ſame reaſon, the increaſe of force obtained by triturating powder for a long time, and the force which damaged powder reſumes after having undergone a freſh proceſs, proceed not, as ſome think, from the greater quantity of air compreſſed into the ſubſtance of the powder, but ſimply from

from a more exact mixture of the ingredients, whence they more easily and generally take fire.

In illustration of this remark, it is sufficient to observe, that the best manufactured powder is liable to be damaged by excessive heat or moisture. The powder-makers, in drying powder, take care to stir it frequently, and suffer it to cool before they put it into the barrels; as they pretend that it ferments when very hot: and in fact, if, when much heated, it be closed up in a barrel for some hours, and afterwards poured gently upon a cloth, a great part of the grains, especially those towards the middle of the barrel, will be caked together; on examining them carefully, it will be found to be owing to the great heat, which having liquefied the sulphur, it glues the grains together when cold: but this never happens if the powder be allowed to cool before it is put into the barrel.

A partial or total liquefaction of the sulphur is always prejudicial to the inflammation

flammation and quick destruction of the powder, as it destroys the exact mixture of the ingredients, which can only be recovered by subjecting it to a fresh process. If the heat be not sufficient to liquefy the sulphur, a large quantity of dust, consisting principally of sulphur and charcoal, will be found in barrels of powder that have been long manufactured and exposed to damp.

The powder from which this dust is detached will be altered in quality; and while the interior of the grains, from which the sulphur and charcoal are fallen off, continue in the same state they were in when made, the exterior will have lost the greater part of the substances necessary to facilitate the inflammation.

Thus, on applying fire to these grains, the surface burns slowly till the fire penetrates the interior, and meets a sufficient quantity of sulphur and charcoal; the powder must therefore have become weaker. Now, if the powder, thus reduced in strength, be manufactured again, the grains will become homogeneous, both internally

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and externally; but, owing to the diminution of the quantity of ſulphur and charcoal, they will be altered in quality, ſince the ſaltpetre will be in greater proportion than either of the other two ingredients; ſo that if, before the powder became damp, it was not very ſtrong, it will now have become much ſtronger; but, on the contrary, if it was as ſtrong as poſſible before, and the ingredients well proportioned and intimately mixed together, it will in this new operation have loſt part of its ſtrength. Hence it may be inferred, that grinding ſerves only to mix the ingredients together; and that when there is a perfect contact between the nitrous and combuſtible particles, it is uſeleſs any longer to continue the operation.

Powder, however well dried and fabricated it may have been, loſes its ſtrength when allowed to become damp. If daily obſervations on powder put into damp magazines, and carefully preſerved in barrels, are not ſufficient to eſtabliſh

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this fact, the following experiment will render it inconteſtable.

Let a quantity of well dried powder be nicely weighed, and put into a cloſe room, where the air is temperate, and ſeemingly dry, and be left for three or four hours; on weighing it again, its weight will be increaſed. This ſame powder, expoſed to an air loaded with vapour, acquires much additional weight in a ſhort time. Now the increaſe of the weight being proportional to the quantity of vapour contained in the atmoſphere, and to the length of time that the powder is expoſed to it; it follows, that powder eaſily attracts moiſture.

Wherefore, if a degree of heat, ſufficient only to fire dry powder, be applied to powder that is damp, the moiſture will oppoſe the action of the fire, and the grains either will not take fire at all, or their inflammation will be ſlower: thus, as the fire will ſpread more ſlowly, fewer grains will burn; and the penetration

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of the fire from the surface to the centre of each grain, and consequently their consumption, will require more time. Whence it may be concluded, that all degrees of moisture diminish the force of powder. Saltpetre, not sufficiently refined, attracts moisture very readily; and as the substances that render it impure lessen the quantity of fluid, and prevent its detonation, it should be refined as much as possible before it is employed in the fabrication of gunpowder.

Having thus shewn that the force of powder is owing to an elastic fluid generated at the explosion, the suddenness of which depends upon the proportion of the ingredients, the contact between the nitrous and combustible particles, and the size of the grains, &c. it may be concluded, that when several powders, equally well dried, and fired under the same state of the atmosphere, are compared together, that which produces the greatest quantity of the elastic fluid, in a given space of time, is the strongest.

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There are two general methods of examining gunpowder; one with regard to its purity, the other with regard to its ſtrength.

Its purity is known by laying two or three little heaps near each other upon white paper, and firing one of them. For if this takes fire readily, and the ſmoke riſes upright, without leaving any droſs or feculent matter behind, and without burning the paper, or firing the other heaps, it is eſteemed a ſign that the ſulphur and nitre were well purified, that the coal was good, and that the three ingredients were thoroughly incorporated together: but if the other heaps alſo take fire at the ſame time, it is preſumed, that either common ſalt was mixed with the nitre, or that the coal was not well ground, or the whole maſs not well beat and mixed together; and if either the nitre or ſulphur be not well purified, the paper will be black or ſpotted.

For proving the ſtrength of gunpowder, a number of machines have been invented, all of which are liable to many objections, and

and upon trial with the ſame powder, are found to give reſults ſo different, that no dependence can be placed in them; to ſo many modifications are the principal properties of powder ſubject, even in experiments conducted with the utmoſt care. Theſe variations have been attributed, by many, to the different denſity of the atmoſphere at the time of the different experiments; but the opinions upon this matter are ſo improbable in themſelves, and ſo contradictory to each other, that they claim neither attention nor belief. Thus, ſome will have it, that gunpowder produces the greateſt effect in the morning and evening, when the air is cool and denſe; whilſt others aſſert, that its force is greateſt in ſunſhine, and during the heat of the day. Mr. Robins concludes from the reſult of ſeveral hundred trials, made by him at all times of the day, and in every ſeaſon of the year, that the denſity of the atmoſphere has no effect in this matter, and that we ought to attribute the variations obſerved at theſe times, to ſome other cauſe than the ſtate of the air:

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probably they are owing to the imperfection of the instrument, or to the manner in which the trial was conducted. In this state of uncertainty then upon the theory of the effects of gunpowder, we remain at this day.

If experiments, however, are made with the prover, great care must be taken, not to press the powder in the smallest degree into the tube of the instrument, but to pour it gently in; and particularly in trying the strength of different powders, which is the best use to which the instrument, imperfect as it is, can be applied, attention must be paid, that one powder is not pressed closer than another at each experiment, nor the successive experiments made until the prover is cool, otherwise no comparative certainty can be gained.

By far the most certain method, however, of determining the quality of powder, is by drying some of it very well, and then trying how many sheets of paper it will drive the shot through, at the distance of ten or twelve yards. In this trial we should be

careful to employ the ſame ſized ſhot in each experiment, the quantity both of the ſhot and the powder being regulated by exact weight; otherwiſe we cannot, even in this experiment, arrive to any certainty in comparing the ſtrength of different powders, or of the ſame powder at different times.

Powder ought to be kept very dry; every degree of moiſture injures it. Good powder, however, does not readily imbibe moiſture; and, perhaps, there is no greater proof of the bad quality of powder, than its growing damp quickly when expoſed to the air: this readineſs to become moiſt, depends upon the ſaltpetre employed in the compoſition not having been freed from the common ſalt it contains in its crude ſtate, and which in conſequence has a very ſtrong attraction for watery particles.

Powder may acquire a ſmall degree of dampneſs, and be freed from it again by drying, without much injury to its quality. But if the moiſture is conſiderable, the ſaltpetre is diſſolved, and the intimate mixture

of

of the ſeveral ingredients thereby entirely deſtroyed. Drying powder with too great a heat alſo injures it; for there is a degree of heat, which, although not ſufficient to fire the powder, will yet diſſipate the ſulphur, and impair the compoſition by deſtroying the texture of the grains. The heat of the ſun is, perhaps, the greateſt it can with ſafety be expoſed to, and, if properly managed, is ſufficient for the purpoſe: when this cannot be had, the heat of a fire regulated to the ſame degree, may be employed; and for this end, a heated pewter plate is perhaps as good as any thing, becauſe pewter retains ſo moderate a heat, that there can be little danger of ſpoiling the powder by producing the conſequences before mentioned.

It is obſervable that damp powder produces a remarkable foulneſs in the fowling piece after firing, much beyond what ariſes from an equal quantity of dry powder; and this ſeems to ariſe from the diminution of the activity of the fire in the exploſion.

Unleſs the ſportſman is very particular indeed

deed in the mode of keeping his powder, we would recommend him always to air it and his flaſk, before he takes the field.

Flaſks made of copper or tin, are much better for keeping powder in than thoſe made of leather, or than ſmall caſks: the necks of theſe ſhould be ſmall, and well ſtopped with cork.

SHOT.

THE choice of this article is highly worthy of the ſportſman's care. It ſhould be equal, round, and void of cavities. *The patent milled ſhot* is, at this time, to be preferred to all other ſorts, and is in ſuch general uſe, that the inſtructions which here follow on the ſize of ſhot to be adopted in the different chaces, muſt be underſtood to relate to the Patent Shot only.

The difference, however, which ſubſiſts between the ſizes of patent and of common ſhot, will be hereafter ſhewn by means of a table, denoting the number of pellets con-

tained in a given weight of each; ſo that in caſes where the former cannot be procured, it will be eaſy to adapt the rules there laid down, to the latter, by only taking the ſame number of grains in the common, as directed to be uſed for the patent ſhot.

It is extremely important for the ſucceſs of the chace, that the ſportſman ſhould proportion the ſize of his ſhot, as well to the particular ſpecies of game he means to purſue, as to the ſeaſon of killing it. Thus, in the firſt month of partridge ſhooting, ſhot No. 1. ſhould be uſed; for ſince, at this time, the birds ſpring near at hand, and we ſeldom fire at more than the diſtance of forty paces, if the ſhooter takes his aim but tolerably well, it is almoſt impoſſible for a bird at this diſtance to eſcape in the circle, or diſk, which the ſhot forms.

Hares alſo, at this ſeaſon of the year, ſit cloſer; and being at the ſame time thinly covered with fur, may eaſily be killed with this ſized ſhot, at thirty or thirty-five paces.

In ſnipe and quail ſhooting, this ſized ſhot is peculiarly proper; for, in uſing a larger

larger ſize, however true the ſportſman may ſhoot, yet he will frequently miſs; the objects being ſo ſmall, that they have great chance of eſcaping in the vacant ſpaces of the circle or diſk. Yet there are many ſportſmen who ſhoot ſnipes, quails, and fieldfares, in countries where they abound, with the ſizes *ſix* and *ſeven* of the common ſhot, the laſt of which is called muſtard-ſeed.

About the beginning of October, at which time the partridge are ſtronger in the wing, *number three* is the proper ſhot to be uſed. This ſize ſeems to be the beſt of any; it preſerves a proper medium between ſhot too large, and that which is too ſmall, and will kill a hare, from the diſtance of thirty-five to forty paces; and a partridge at fifty; provided the powder be good. It will ſerve alſo for rabbit ſhooting. In ſhort, it is excellent for all ſeaſons, and many ſportſmen uſe no other the ſeaſon round.

It is true, that diſtant objects are frequently miſſed for the want of larger ſhot; but then theſe bear no proportion to the number which are daily miſſed, by uſing ſhot of too

large a ſize, eſpecially with the feathered game. If a man was to ſhoot conſtantly with ſhot *number five*, for one partridge which he might chance to kill with a ſingle pellet, at the diſtance of eighty paces, he would miſs twenty birds at fifty paces, which would in ſuch caſe eſcape in the vacant ſpaces of the circle. But if the ſportſman expreſsly propoſes to ſhoot wild-ducks, or hares, then, indeed, he had better uſe the *number five*. However, in ſhooting with a double-barrelled gun, it may be prudent to load one of the barrels with large ſhot, for the neceſſary occaſions; and if in any caſe large ſhot is required, *number five* will be found to be better than any other; for its ſize is not ſo large as to prevent it from ſufficiently garniſhing, or being equally ſpread in the circle, and it can at the ſame time perform, in effect, all that a larger-ſized ſhot can do, which garniſhes but very little, if any at all.

In order, therefore, to ſhew clearly, and at one view, the comparative difference in the garniſhing of ſhot of different ſizes; we here ſubjoin a table, which indicates the num-

number of pellets precisely composing an ounce weight of each sort of shot, the patent and the common, commencing at the smallest size in each.

PATENT SHOT.

No.	8	1 ounce	- - -	620
	7	id.	- - -	480
	* ×	id.	- - -	300
	1	id.	- - -	220
	2	id.	- - -	180
	3	id.	- - -	157
	4	id.	- - -	105
	5	id.	- - -	83

* The Reader will observe, that the patent shot has no No. 6, the × being substituted in its place, and that the numbers do not follow each other in the order of progression: the reason of this we cannot assign.

We have been lately informed, that the manufacturer of this shot has, with a sufficient degree of caprice, totally altered the numbers, to the great inconvenience of the shooter, who, in ordering the former numbers, has different sizes than formerly sent him.

COMMON SHOT.

No.	7	1	ounce - - -	350
	6		id. - - -	260
	5		id. - - -	235
	4		id. - - -	190
	3		id. - - -	140
	2		id. - - -	110
	1		id. - - -	95

The Proportions of Powder and Shot in the Charge.

TO find the charge that gives the longeſt range in fowling pieces of different dimenſions, muſt be allowed to be a diſcovery of infinite importance to every ſportſman; and as it ſeems to be an opinion pretty generally received and eſtabliſhed, that every barrel has a *particular* load (not a meaſure eſtimated by any rules to be drawn from a compariſon made between the proportions of the caliber and the length of the barrel) with which it will ſhoot with greater certainty

tainty and effect; it cannot be doubted that he will make some experiments with his own barrels, in order to attain this end. Before we proceed, therefore, to lay down a few general rules for the loading of fowling pieces of different dimensions, we beg leave to engraft an excellent principle, in the practice of the Artillery on this point, upon the shooting science. It is asserted, that by using small charges at first, and increasing the quantity of powder by degrees, the ranges will increase to a certain point; after which, if the charge be augmented, they will progressively diminish; though the recoil will still continue in the ratio of the increase of the charge. This is a consequence that may be deduced from a variety of experiments, and is perfectly agreeable to the principles of mechanics; since the recoil and the range ought to be in the reciprocal ratio of the gun and the shot, making allowance for the resistance which these bodies meet with.

For a fowling piece of a common caliber, which is from twenty-four to thirty balls to the pound weight; a dram and a quarter,

or, at moſt, a dram and a half, of good powder; and an ounce, or an ounce and a quarter, of ſhot, is ſufficient. But when ſhot of a larger ſize is uſed, ſuch as *number five*, the charge of ſhot may be increaſed one-fourth, for the purpoſe of counterbalancing, in ſome degree, what the ſize of the ſhot loſes in the number of pellets, and alſo to enable it to garniſh the more. For this purpoſe, the ſportſman will find a meaſure marked with the proper gages, very convenient to him. An inſtrument of this nature has been made by an ingenious artiſt of this town, Egg, of the Haymarket.

Different opinions, however, are entertained on the proportions of the charge. Some determine the charge of a fowling piece, by the weight of a ball of the exact ſize of the caliber; eſtimating the weight of the powder at one-third of that of the ball, whether it is propoſed to ſhoot with ball or with ſhot; and the weight of the ſhot they eſtimate at amoiety more, or, at the moſt, at double the weight of the ball. This calculation comes pretty near to the

proportions we have juſt laid down, except in the difference of ſize between the calibers twenty-four and thirty, which, notwithſtanding, is not ſufficiently great in the two caſes, to require a gradation in the weight of the charge.

Others again lay down as a rule for the charge of powder, a meaſure of the ſame diameter as the barrel; and double that diameter in depth: and for the ſhot, a meaſure of the like diameter, but one-third leſs in depth than that for the powder. This alſo agrees tolerably well with the proportions we have mentioned, at leaſt for the powder, but the meaſure of ſhot ſeems to be too ſmall.

In ſhooting ball with a rifle piece, ſome perſons proportion the quantity of powder, to three times the quantity which the mould of the ball adapted to the piece, will contain.

Although proverbs are generally true, or at leaſt poſſeſs ſome portion of truth; yet nothing is ſo glaringly abſurd, or leſs founded in rational principles, than that old adage,

"*ſparing*

"*ſparing of powder, and liberal of ſhot:*" a ſaying, which is not only in the acquaintance, but in the conſtant practice of moſt ſportſmen.

As a conſequence of overloading with ſhot, the powder has not ſufficient ſtrength to throw it to its proper diſtance; for if the object fired at be diſtant, one-half of the pellets compoſing the charge, by their too great quantity and weight, will ſtrike againſt each other, and fall by the way; and thoſe which reach the mark, will have ſmall force, and will produce but little or no effect. Thus to overload, is the ſtrange fancy of poachers, who imagine they cannot kill unleſs they put two ounces, or more, of large ſhot into their pieces. It is true, that they deſtroy a great quantity of game, but then it is not fairly ſhot. Such men are in ſome meaſure puniſhed by the ſevere ſtrokes they receive on the ſhoulders and cheeks, in conſequence of the exceſſive recoil.

WADDING.

MANY ſportſmen are of opinion, that the wadding, of whatever material it may be compoſed, or whether it be rammed looſe, or tight, into the barrel, has no effect, either on the range of the ſhot, or the cloſeneſs with which they are thrown. Now, although it may be granted, that the material which covers the ſhot, and which is uſed only for the purpoſe of keeping it down, is of little importance, yet, the ſubſtance which covers the powder is undoubtedly of much conſequence. It ſhould be quite cloſe in the barrel, and that without being rammed too hard; the wadding ſhould therefore be of a ſoft and tractable material, but at the ſame time of ſufficient conſiſtence, to carry the ſhot in a body, to a certain diſtance from the muzzle of the piece. For, if the wadding is rammed too cloſe, or is of a hard and rigid ſubſtance, ſuch as ſtiff brown paper, the piece will recoil, and the ſhot will ſpread more wide: if, on the contrary, the wadding is not ſufficiently

ficiently close, and is composed of a slight and too pliant a material, such as wool or cotton, it will not be of consistence enough to carry the shot, and the discharge will lose its proper force. Besides, a certain portion of the shot which is more immediately in contact with the wadding, will be melted by the explosion of the powder.

In the former part of this treatise, where we treated of the *shot* of fowling pieces, we have given our reasons for preferring wadding made of hat, by means of a punch fitted to the bore of the piece, to every other; but as this is not easily procured in sufficient quantity, we must employ something that is at once cheap, and adequate to the purpose.

Next to hat, therefore, experience teaches, that nothing is better for wadding than soft brown paper; it combines suppleness with consistence, and moulds itself to the barrel: and it is further observable, that such wadding never falls to the ground, in less than twelve or fifteen paces from the muzzle of the piece.

In

In countries where orchards abound, a very ſine moſs, of a greeniſh grey colour, is found adhering to the apple trees, which is extremely proper for wadding, and which even poſſeſſes the extraordinary quality, of making the barrel leſs greaſy and foul than paper, which always contains a certain quantity of oil. Tow is alſo very good for this purpoſe. A cork wadding has been extolled for the virtue of increaſing the range and cloſeneſs of the ſhot of pieces; we have not made the experiment, but it ſeems probable, that a wadding of cork, adapted to the caliber of the piece, may produce a greater effect, than a wadding of paper, in theſe reſpects, that by ſtopping the barrel more hermetically, it prevents the elaſtic fluid, produced by the exploſion of the powder, from eſcaping in any way, between the partition of wadding and the charge, preſerves all its force to the mouth of the gun, and thereby renders the effect of the powder greater. Theſe principles have been already applied to the wadding of hat, and to which therefore we refer the reader.

We

We have now, however, to ſpeak of another ſpecies of wadding, and which has novelty, at leaſt, to recommend it; but, in truth, it may be preferred to hat wadding, for the principles of that equally apply to this, and it poſſeſſes one great advantage in the circumſtance of not fouling the barrel ſo much as the other. The wadding to which we allude is made of the cloth called *Fearnought*, or *Shepherds Cloth* (which is very generally known), and punched by the ſame inſtrument as formerly mentioned for hat wadding; but it muſt not be *dyed*, for the acid which is uſed to *ſet* the colour will ruſt the inſide of the barrel immediately in contact with it, and eſpecially if the gun is laid by charged. Some ſportſmen uſe it upon both the powder and ſhot; but by experience we find, in proof of our former opinion on this matter, that it ſhould only cover the powder; for, when laid upon the ſhot, they are, in conſequence, more ſcattered in the diſcharge.

We alſo find, that wadding compoſed of this material is much cheaper than hat: the

the coſt is from 1s. 6d. to 2s. per yard, according to the quality and thickneſs, and a yard will cut into 1536 pieces of wadding for a barrel of a common caliber.

As wadding, either of hat or the cloth we have juſt mentioned, is apt (if the ramrod is not ſufficiently broad at the top) to be driven down edgeways, we recommend the ſportſman to put it down with the ſcrew-end, giving the ſcrew a ſingle turn round into the cloth, and when it reaches the powder, to turn the other end of the ramrod and fix it level, uſing no force in ramming it home, and keeping the gun as nearly perpendicular as poſſible during the operation.

CHAP.

CHAP. XIII.

Method of loading a Fowling Piece.

SOME attention is requiſite in loading a piece; the powder ſhould be only ſlightly rammed down, for which purpoſe, it is ſufficient to preſs the ramrod two or three times on the wadding, and not (as the uſual practice is) to ram down the wadding by main force, by drawing up the ramrod, and then returning it into the barrel with a jerk of the arm, many ſucceſſive times. For, by compreſſing the powder in this violent manner, ſome of the grains will neceſſarily be bruiſed, whilſt the exploſion will not be ſo quick, and the ſhot will be ſpread wider.

In pouring the charge of powder into the barrel, care ſhould be taken, to hold the meaſure as much as poſſible in a perpendicular

cular line, that the powder may the more readily fall to the bottom. It is even of ſervice to ſtrike the butt end of the gun on the ground, in order to detach thoſe grains of powder, which, in falling down, adhere to the ſides of the barrel.

The ſhot ſhould never be rammed down tight: after having given a ſtroke on the ground with the butt end of the gun, in order to ſettle it, the ſame as for the powder, the wadding ſhould then be gently put down, but much leſs cloſe than that over the powder; for when the ſhot is wadded too tight, it ſpreads wide, and the piece will recoil. In this, therefore, as well as in every other mode of loading, the ſportſman ſhould never carry his gun under his arm, with the muzzle inclined to the ground; that practice at all times looſens the wadding and charge too much, ſometimes produces the loſs of the ſhot, and always indicates lazineſs in the ſhooter, and indifference to the ſport.

When the piece is fired, it ſhould, if poſ-

ſible, be re-loaded immediately, whilſt the barrel is warm, leſt by delaying it, a certain moiſture ſhould be formed in the barrel, which would retain a part of the powder when pouring in the charge, and hinder it from falling to the bottom.

Powder, alſo, as already mentioned, will imbibe moiſture from the air, and therefore it is of additional advantage, to load the piece whilſt the barrel is warm, becauſe ſome part of the moiſture will be thereby evaporated.

For the ſame reaſons, the ſportſman ſhould fire off a little powder before he loads the firſt time, for it has been found, even in the drieſt ſeaſons, that the coldneſs of the barrel, and perhaps ſome little moiſture condenſed in its cavity, have ſenſibly diminiſhed the force of the powder, in the firſt diſcharge.

Some ſportſmen prime before they load: this may be proper when the touch-hole is enlarged, and the barrel is very thin at that place, becauſe, in that caſe, if the piece is not firſt primed, it will in loading prime itſelf,

itself, which diminishes the charge; but when the touch-hole is of its proper size, the piece should never be primed until after it is loaded; for then it will be known from the few grains of powder which usually make their way into the pan, that the touch-hole is clear and unobstructed; and on the contrary, if no grains come through, that it will be proper to strike the butt of the gun smartly with the hand, and to prick the touch-hole until they appear.

But, whether the practice is to prime before or after loading the piece, it is highly proper, after every discharge, to prick the touch-hole, and what is still better, to guard against all remains of fuze or squib, by inserting into the touch-hole the feather of a partridge's wing, which will not only clear it of these dangerous remains, but, if the piece is delayed to be re-charged, will take away all humidity that may be contracted there.

CHAP. XIV.

Instructions for Shooting well.

EVERY sportsman has his own manner of bringing his gun up to his shoulder, and of taking aim; and each follows his own fancy with respect to the stock of his fowling-piece, and its shape. Some like it short, others long; one prefers it straight, another bent.

And although there are some sportsmen, who shoot equally well with pieces stocked in different ways and shapes, yet certain principles may be laid down, as well upon what is the proper length, as upon the proper degree of bent, that the stock of a gun should have. But in the application, those principles are very frequently, nay most commonly counteracted, by the

whim, or the particular convenience of the ſhooter.

Generally ſpeaking, however, it is certain, that for a tall, long-armed man, the ſtock of a gun ſhould be longer, than for one of a leſs ſtature, and ſhorter arm. That a ſtraight ſtock is proper for him who has high ſhoulders, and a ſhort neck; for, if it be much bent, it would be very difficult for him, eſpecially in the quick motion required in ſhooting at a flying or running object, to place the butt of the gun-ſtock firmly to the ſhoulder; the upper part alone would in general be fixed, which would not only raiſe the muzzle, and conſequently ſhoot high, but make the recoil be much more ſenſibly felt, than if the whole end of the ſtock were firmly placed on his ſhoulder. Beſides, ſuppoſing the ſhooter to bring the butt home to his ſhoulder, he would ſcarcely be able to level his piece at the object. On the contrary, a man with low ſhoulders, and a long neck, requires a ſtock much bent; for, if it is ſtraight, he will, in the act of lowering

his head to that place of the ſtock at which his cheek ſhould reſt, in taking aim, feel a conſtraint, which he never experiences, when, by the effect of the proper degree of bent, the ſtock lends him ſome aſſiſtance, and, as it were, meets his aim half way.

Independent, however, of theſe principles, the application of which is ſubject to a variety of modifications; we venture to adviſe the ſportſman in the choice of a fowling piece, that a long ſtock is preferable to a ſhort one, and at the ſame time, rather more bent than uſual; for a long ſtock ſits firmer to the ſhoulder than a ſhort one, and particularly ſo, when the ſhooter is accuſtomed to place his left hand, which principally ſupports the piece, near to the entrance of the ramrod into the ſtock.

The practice of placing that hand near the bridge of the guard, is, undoubtedly, a bad one; the aim is never ſo ſure, nor has the ſhooter ſuch a ready command over his piece, as when he places his hand near the entrance of the ramrod, and, at the ſame time, ſtrongly graſps the barrel; in-

ſtead of reſting it between his fore-finger and thumb, in conformity with the general cuſtom. It may, therefore, be depended upon, that a ſtock, bent a little more than ordinary, is better for ſhooting true, than one too ſtraight, becauſe the latter, in coming up to the aim, is ſubject to the inconvenience of cauſing the ſportſman to ſhoot too high.

We would alſo adviſe him to have his fowling-piece a little elevated at the muzzle, and the ſight ſmall and flat; for, the experienced well know, that it is more uſual to ſhoot low than high. It is, therefore, of ſervice, that a piece ſhould ſhoot a little high, and then the more flat the ſight, the better the line of aim will coincide with the line of fire, and of conſequence, the gun will be leſs liable to ſhoot low.

The method by which to avoid miſſing a croſs ſhot, whether it be flying, or running, is, not only to take aim before the object, but likewiſe not involuntarily to ſtop the motion of the arms, at the mo-

ment of pulling the trigger; for the inſtant the hand ſtops in order to fire, although the ſpace of time is almoſt imperceptible, the object, if a bird, gets beyond the line of aim, and the ſhot will fly behind it; and if a hare or rabbit is ſhot at in this manner, whilſt running, and eſpecially if at a diſtance, the animal will only be ſlightly ſtruck in the buttocks, and will be taken but by hazard. When a bird, however, is flying in a ſtraight line from the ſhooter, this fault can do no harm; the object can ſcarcely eſcape, if the piece be but tolerably well directed, unleſs, indeed, it is fired at the moment the game ſprings, and before the birds have taken a horizontal flight. In that caſe, if the hand ſhould ſtop ever ſo little, at the inſtant of firing, the ſportſman will ſhoot low, and inevitably miſs the mark.

It becomes, therefore, extremely eſſential to accuſtom the hand, in taking aim, to follow the object, without ſuſpending the motion in the leaſt degree, which is

a ca-

a capital point towards acquiring the art of ſhooting well : the contrary habit, which it is very difficult to correct, when once contracted, prevents that perſon from attaining perfection in the art, who, in other reſpects, may eminently poſſeſs quickneſs of ſight, and ſteadineſs of aim.

Nor is it leſs eſſential in a croſs ſhot, to aim before the object, in proportion to its diſtance, at the time of firing. If a partridge, for inſtance, flies acroſs at the diſtance of thirty, or five-and-thirty paces, it will be ſufficient to take aim at the head, or, at moſt, but a ſmall ſpace before. The ſame rule will nearly hold in the caſes of ſhooting quail, woodcock, pheaſant, or wild duck, although thoſe birds move their wings ſlower than the partridge. But, if the object is fifty, ſixty, or ſeventy paces diſtant, it then becomes neceſſary to aim at leaſt half a foot before the head.

The ſame practice ſhould be obſerved, in ſhooting at a hare, or rabbit, when running in a croſs direction, making due allowance for the diſtance, and for the

ſwiftneſs

ſwiftneſs of the pace, which is not always the ſame.

It is alſo proper, in ſhooting at an object very diſtant, to take aim a little above it, becauſe ſhot, as well as ball, have but a certain range in point blank, beyond which, each begins to deſcribe the *curve* of the *parabola**.

When a hare runs in a ſtraight line from the ſhooter, he ſhould take his aim between the ears, otherwiſe he will run the hazard either of miſſing, or at leaſt of not killing dead, or, as it is ſometimes called, "*clean.*" A true ſportſman, who has the ambition of ſhooting well, is not content with only breaking the wing of a partridge, or the

* Some authors celebrated for their mathematical Tracts on Gunnery, are of a different opinion as to the track deſcribed by the ball in its flight. We will here only mention Euler, a German writer, who inſiſts that, the reſiſtance of the air to ſwift motions being very great, the curve deſcribed by the ball is neither a parabola, nor near it; and after various algebraic proofs, he infers, that, by reaſon of this reſiſtance, the angle which gives the greateſt amplitude is not forty-five degrees, as commonly ſuppoſed, but ſomething leſs.

thigh

thigh of a hare, when he ſhoots at a fair diſtance; for in ſuch caſe, the hare, or the partridge, ought to be ſhot in ſuch a manner, that it ſhould remain in the place where it falls, and not require the aſſiſtance of the dogs to take it.

——Now mercy goes to kill,
And ſhooting well is then accounted ill.
Thus will I ſave my credit in the ſhoot;
Not wounding, pity would not let me do't.

SHAK.

But, if he ſhoots at a great diſtance, it is no reproach that the partridge is only winged, or the hare wounded, ſo that it cannot eſcape.

Practice ſoon teaches the ſportſman the proper diſtance at which he ſhould ſhoot. The diſtance at which he ought infallibly to kill any kind of game, with patent ſhot, No. 3. provided the aim be well taken, is, from twenty-five to thirty-five paces, for the footed; and from forty to forty-five paces, for the winged game. Beyond this diſtance, even to fifty, or fifty-five

paces,

paces, both partridge and hares are ſometimes killed, but, in general, the hares are only ſlightly wounded, and carry away the ſhot; and the partridge, at that diſtance, preſent ſo ſmall a ſurface, that they frequently eſcape untouched between the vacant ſpaces of the circle. Yet, it does not follow that a partridge may not be killed with No 3. patent ſhot, at ſixty, and even ſeventy paces diſtance, but then theſe ſhots are very rare.

Thoſe who know the range of a fowling-piece, and the cloſeneſs of its ſhot, ſhrug up their ſhoulders at the romances of thoſe ſportſmen, who, by their own accounts, daily kill, with ſhot No. 3. at the diſtance of ninety, and one hundred paces. Nay, ſome even go ſo far, as to aſſert, that they have killed, with this ſized ſhot, hares, at one hundred and ten paces, and pheaſants, at one hundred and twenty. It cannot, however, be denied, that with ſhot No. 5. a man may have killed a hare or a partridge at one hundred and ten, or poſſibly at one hundred and twenty paces; but then theſe

ſhots

ſhots are ſo extraordinary, and occur ſo ſeldom, that the whole life of a ſportſman will ſcarcely afford more than two or three inſtances; and, when it does happen, it will be found to be by a ſingle pellet, which, by great chance, has hit either the wing or the head of the partridge, or has ſtruck the head of the hare, by which he is ſtunned, or, perhaps, has penetrated the ſmall part of the ſhoulder, where there is, to prevent the wound being mortal, only a very thin ſkin, which being ſtretched by the animal in running, is thereby rendered more eaſy to be pierced with the ſhot.

As a means of attaining the art of ſhooting flying, many young ſportſmen are adviſed to ſhoot at ſwallows; but the flight of theſe birds is ſo irregular and ſwift, and at the ſame time ſo unlike the motion of thoſe birds which are the object of ſport, that we think it a bad method. No mode is ſo advantageous as the actual practice of ſhooting the game, whereby that trepidation and alarm, which moſt men feel upon the riſing of the covey, will be ſooner conquered; for, while

while theſe are poſſeſſed, even in the moſt trifling degree, no one will attain to be a ſteady and good ſhot.

This opinion is confirmed and enforced by ſuch beautiful and deſcriptive language in the poem we have before cited, that we are tempted to give another quotation from the ſame work, not doubting that our readers will excuſe us.

But vainly ſhall preceptive rules impart
A perfect knowledge of this manly art;
Practice alone can certain ſkill produce,
And theory confirm'd by conſtant uſe.
The hardy youth, who pants with eager flame
To ſend his leaden bolts with certain aim,
Muſt ne'er with diſappointed hopes recoil
From cold and heat, from hunger and from toil;
Muſt climb the hill, muſt tread the marſhy glade,
Or force his paſſage through th' oppoſing ſhade;
Muſt range untam'd by Sol's meridian pow'r,
And brave the force of winter's keeneſt hour,
Till induſtry and time their work have wrought,
And honour crown the ſkill that labour taught.
Yet ſome, theſe harſher rudiments to ſpare,
And equal art with eaſier toil to ſhare,

Or

Or watch with careful aim and ready ſight
The ſwallow wheeling in her ſummer flight,
Or on ſome lofty cliff, whoſe chalky ſteep
Hangs with rude brow impending o'er the deep,
Where gulls and ſcreaming ſea-mews haunt the rock,
Pour fire inceſſant on the mingled flock.
But vain their hopes—preſented to the eye
In ſuch diverſive lines the objects fly,
That the 'maz'd ſight unnumber'd marks purſues,
Uncertain where to aim, and which to chooſe;
Deciſion quick and calm, the ſhooter's boaſt,
By frequent change, is check'd, confus'd, and loſt;
And, guarded by irreſolute delay,
Untouch'd ſhall future coveys fleet away.
More hurtful ſtill to try with diſtant blow
To bring the percher from th' aerial bough.
How ſhall his thoughts, the level that prepare
With all the caution of mechanic care,
Exact and ſteady as the ſage's eye
Through Galileo's tube ſurveys the ſky,
With ready view the tranſient object ſeize
Swift as the motion of the rapid breeze,
Purſue th' uncertain mark with ſwift addreſs,
And catch the fleeting moment of ſucceſs?

If,

If, however, there are perſons who ſtill think the practice of ſhooting ſwallows to be of aſſiſtance in acquiring the art, we will venture to recommend another mode, which is nearly ſimilar, but, in our opinion, much better. This is, by putting ſmall pieces of white paper round the necks of ſparrows, or other ſmall birds, by the means of a hole cut in the middle of the paper; then, throwing a ſingle bird into the air, the young ſhooter may deliberately take his aim; for, by this device, the flight of the bird is rendered leſs rapid, and more regular, and at the ſame time preſents a much better mark for practice. Beſides, it affords an excellent diverſion in ſeaſons when game cannot be purſued, or in wet weather, from underneath the ſhelter of a ſhed, or a barn door. Some of the firſt ſhots in the kingdom have been perfected by this mode.

A fowling-piece ſhould not be fired more than twenty, or five-and-twenty times, without being waſhed; a barrel, when foul, neither ſhoots ſo ready, nor carries the ſhot ſo far, as when clean. The flint, pan, and hammer,

hammer, ſhould be well wiped after each ſhot; this contributes greatly to make the piece go off quick; but then it ſhould be done with ſuch expedition, that the barrel may be reloaded whilſt warm, for the reaſons we have before advanced. The flint ſhould be frequently changed, without waiting until it miſſes fire, before a new one is put in. Fifteen or eighteen ſhots, therefore, ſhould only be fired with the ſame flint; the expence is too trifling to be regarded, and by changing it thus often, much vexation will be prevented.

A gun, alſo, ſhould never be fired with the prime of the preceding day; it may happen that an old priming will ſometimes go off well, but it will more frequently contract moiſture and fuze in the firing; then the object will moſt probably be miſſed, and that becauſe the piece was not freſh primed.

For the uſe and convenience of thoſe who love the ſport of ſhooting water-fowl, we will here inſert an infallible receipt to exclude water and dampneſs from penetrating their

 boots.

boots. For this purpofe the boots fhould be made of foft cow leather, well feafoned, and rendered as much water proof as they can be, by the quality of the leather and the clofenefs of the fewing.

Take of Tallow, half a pound,
Hogs lard, four ounces,
Turpentine, two ounces,
New bees wax, two ounces,
Olive oil, two ounces.

Melt the whole together in an earthen pipkin over the fire, and ftir it well while melting.

The night before it is propofed to go a fhooting water-fowl, care muft be taken, that the boots have no dampnefs; they muft then be warmed gradually at a clear fire, and, when well heated, muft be liberally anointed with the preceding compofition, which fhould be previoufly melted to fuch a degree of heat that the hand can but juft bear it; fo much of this compofition fhould be applied as the leather will fuck up, in repeated rubbings. On the next morning, the boots will feel a little ftiff in putting on,

but

but the warmth of the leg will ſoon render them ſupple. When the boots are new, it will be neceſſary to wear them two or three times before they are anointed, in order to take away the oily dreſſing which all new leather has.

With boots thus prepared, the ſportſman may wade whole days in bogs and ſwamps, without fear either of wet or damp, being ſure to return home with dry legs and feet.

CHAP. XVI.

General Instructions on Shooting.

NOtwithstanding the instructions which here follow, may appear minute and superfluous to the experienced sportsman, yet, we trust, the young shooter will not be sorry to find the elements of his profession, or to meet with that information which will in some measure supply the experience he wants; for this reason we presume to lay down a few general precepts for his conduct in the pursuit of the game.

In the first place, he should pay attention to the difference of seasons, and the weather; to the temperature of the air, and even to those hours of the day, which are more or less favourable for shooting. In warm weather he should hunt for the game in plains and in open grounds, at the same time bearing

bearing in mind, that, during the heat of the day, the birds frequent moiſt places, marſhes where there is little water and much high graſs, the ſides of rivers and brooks, and hills expoſed to the north. But, in cold weather, they will moſt commonly be found on little hills expoſed to the ſouth; along hedge-rows; among the heath; in ſtubbles; and in paſtures where there is much furze and fern. In hard froſts, they get into thickets, low places, and marſhes, where they ſeek to ſhelter themſelves from the cold, as well as the heat, in different ſeaſons. The greateſt part, however, of theſe rules will only apply, when the weather is extremely hot, or ſeverely cold, at both of which times, the hares and partridges almoſt totally deſert the plains and open grounds. The game is more eaſily approached, or, in the language of ſporting, "*lyes better*," in covert, than in open places; a double advantage is therefore obtained, by hunting for them in the former.

He ſhould, at all times of the ſhooting ſeaſon, go out in the morning before the

dew is off. At that time, the ſhepherds and their flocks, the huſbandmen and their teams, have not entirely ſpread over the fields, and have as yet ſprung but a ſmall quantity of game; the ſcents of the preceding night will alſo be more warm, and the dogs will hit them off better. Beſides, if he is not early he loſes ſuch opportunities of ſhooting, as he will not meet again, during the remainder of the day.

All theſe advantages, therefore, greatly counterbalance the notion generally received, that, as the birds will not lye well while the ground is wet, the ſportſman ſhould not go out early in the morning, or before the dew is gone off.

The colour of the dreſs which the ſhooter ſhould wear, is worthy notice. Green is unqueſtionably the beſt in the early part of the ſeaſon, whilſt the leaves remain on the trees. For, if he is clad in a glaring colour, when the face of the country retains its verdure, the game will perceive his approach more eaſily, and from a greater diſtance. In winter, for the ſame reaſon, his dreſs

ſhould

ſhould be compoſed of a dark grey, or ſome colour reſembling that of the dead leaf.

It is beſt to hunt as much as poſſible ~~with~~ against the wind; not only to prevent the game from perceiving the approach of the ſportſman and his dog, but alſo to enable the dog to ſcent the game at a greater diſtance. We ſay as much as poſſible, becauſe in advancing and returning upon his ſteps, in order to range the ground well, the ſhooter cannot always keep the advantage of the wind. When, therefore, it is propoſed to hunt any particular tract of country, in which game is expected to be found, it is indiſpenſably neceſſary to take the wind, and it behoves the ſhooter to range and quarter his ground, in ſuch manner and direction, as to preſerve it in his favour.

He ſhould never be diſcouraged from hunting and ranging the ſame ground, over and over again, eſpecially in places covered with heath, brambles, high graſs, or young coppice wood. A hare or rabbit will frequently ſuffer him to paſs ſeveral times within a few yards of its form, without

getting up. He ſhould be ſtill more patient, when he has marked partridge into ſuch places; for it often happens, that after the birds have been ſprung many times, they lye ſo dead, that they will ſuffer him almoſt to tread upon them, before they will riſe. Pheaſants, quails, and woodcocks do the ſame.

He ſhould always keep a ſharp eye, and carefully look round about him, never paſſing a buſh, or tuft of graſs, without examination; but he ſhould never ſtrike either with the muzzle of his gun, for the reaſons aſſigned when we treated of wadding. It is alſo proper to ſtop every now and then; for this interruption of motion, frequently determines the game to ſpring, which would otherwiſe have ſuffered him to paſs. He who patiently beats and ranges his ground over and over again, without being diſcouraged, will always kill the greateſt quantity of game; and if he is ſhooting in company, he will find game where others have paſſed without diſcovering any.

As ſoon as he has fired, he ſhould call in his

his dog, and make him lye down until he has reloaded his piece; for, without this precaution, he will frequently have the mortification to ſee the game riſe, when he cannot ſhoot.

In ſhooting in an open country, one of the moſt eſſential points to be obſerved, is, to mark the place where the partridge alight; therefore, when he has killed his bird, he ſhould not immediately run to pick it up, or attend to make his dog bring it to him, but he ought to follow the others with his eye, until he ſees them ſettle, or as far as his ſight can extend, without interruption from a wood or a hedge. In the latter caſe, although he has not been able to diſtinguiſh the exact ſpot on which they have alighted, yet he may tolerably well gueſs whereabout they are, eſpecially if he is acquainted with the country in which he is ſhooting. And when two or more ſportſmen ſhoot in company, each ſhould mark the birds which fly on his own ſide.

The rules of conduct which we have juſt

laid

laid down in ſhooting partridge, will with equal propriety apply to all the feathered game.

When a hare ſtarts up at a diſtance, it is often of uſe to follow her with the eye, becauſe ſhe will ſometimes ſquat down; and then, if ſhe is left for a little ſpace of time, ſhe may be approached near enough to be ſhot on the form. But if ſhe is perceived to enter a copſe, or ſmall wood, it is ſtill better; in that caſe, the ſportſman ſhould caſt his dogs through that part of the wood where he conceives it probable ſhe has clapped down, and then he may wait for her on that ſide of the wood at which he thinks ſhe will come out.

The deſcription of a particular mode of killing game in an open country, may not be unacceptable to ſome of our readers. Eight men go in a company; four of them equipped with fowling-pieces, and four with ſticks only, for the purpoſe of beating the buſhes, furzes, &c. This band then range in a ſtraight line, the beaters being placed in the

the intervals between the ſhooters, at the diſtance of ten or twelve paces, the whole forming a front of eighty or an hundred paces, ſo that in advancing they ſweep a great tract of country. The beaters, in order to raiſe the game, make a great noiſe with their voices and ſticks. When a covey of partridge ſprings, if one of the company fires, the reſt ſtop until he has reloaded his piece, taking care in the mean time to mark the flight of the birds. If a ſingle bird ſeparates from the covey and is marked down, one of the ſhooters is diſpatched after it, and the others halt until he returns.

Dogs are almoſt unneceſſary in this ſport; at leaſt, one only ſhould be uſed, which ſhould be under perfect command, otherwiſe he ſhould be held in a ſtring, ready to be ſlipped in caſe of need, after a winged partridge, or a wounded hare. If a copſe or ſmall wood intervenes, the beaters enter and range it, while the ſhooters poſt themſelves at the outlets.

This

This method is much ufed in Italy; it is in general a very bloody fport, but feems to be more particularly adapted for places where the game is not in great abundance.

CHAP. XVI.

Inſtructions for Training Pointers.

BEFORE we enter into this matter, we beg the indulgence of our Readers whilſt we ſay a few words in favour of that wonderful animal the Dog, and by deſcribing a few of the extraordinary qualities he poſſeſſes, as well as his amiable diſpoſition, prevail on the generality of the world to treat this faithful ſervant with more tenderneſs and reſpect in future.

Buffon, a man who poſſeſſed the greateſt knowledge of nature and all her works, combined with the happieſt talent of deſcribing them, ſays that the dog, from the great perfection of his intellect, is worthy to enter in ſociety with man; he knows how to aid him in his deſigns, to watch for his ſecurity, to aſſiſt him with his powers, to defend him, to flatter him; he knows, by aſſiduous ſervices

vices and by repeated careſſes, how to conciliate the affections of his maſter and to captivate him, and from a tyrant to make him his protector.

The dog, independent of the beauty and ſymmetry of his form, of his vivacity, and of his agility, eminently poſſeſſes all thoſe interior qualities that can gain the affections of man, whom he ſeduloully ſeeks to pleaſe, and to whom he attaches himſelf with ſo much pleaſure and ſincerity. He approaches in crouching and humble attitude, to lay at the feet of his maſter, his courage, his ſtrength, and his talents; he waits his commands to make uſe of them; for theſe he conſults him, he interrogates him, he ſupplicates him: a ſingle glance of the eye is ſufficient; he underſtands the ſignal of his will; he is all zeal, all ardour, all obedience: more ſenſible of kindneſs than of injury, he is neither repulſed nor diſcouraged by the worſt of treatment; he ſubmits to it, he forgets it, or at leaſt remembers it only to attach himſelf the more. Inſtead of being exaſperated, he willingly expoſes himſelf

himſelf to new trials of ſeverity; he licks the hand that ſtrikes him; to it he oppoſes only a mournful complaint, and at length diſarms it by patience and ſubmiſſion.

More tractable than man, the dog not only imbibes inſtruction in a ſmall ſpace of time, but readily conforms himſelf to the various motions, to the manners, and to all the habits of the ſportſman who commands him. Of what infinite importance is the dog in the order of nature, ſuppoſing for an inſtant that he had never exiſted! Without him, how would man have been able to conquer, to ſubdue, and to reduce to ſlavery the ſavage animals of the foreſt? How could he at this day diſcover, chaſe, and deſtroy the wild beaſts of the field? It is evident, that, to procure perfect ſafety, and to render himſelf maſter of the living univerſe, it would be neceſſary to begin by forming an union with thoſe animals whom he found capable of attachment and obedience, to the intent of oppoſing them to the others. One of the firſt arts of man hath therefore been the education of the

dog;

dog; and the conſequence of this art hath been, the peaceable poſſeſſion of the earth.

Without the dog, man could not have dared pretend to ſuch a conqueſt, becauſe the greater part of animals have more agility, more ſwiftneſs, more ſtrength, and even more courage than man. Nature hath better provided, and better armed them than him: they have ſenſe alſo and the faculty of ſmelling in the moſt perfect degree. To have gained, therefore, a ſpecies of animal, courageous and docile as the dog, was to have acquired a new ſenſe, and faculties which were wanting to us; it was to have diſcovered great and eternal means of conqueſt; it was, in one word, to have immortaliſed the ſportſman and the art of the chace.

After having thus become the advocate of the dog, and ſo warmly recommended him to the favour of his maſter; let not the falſe and affected friends of humanity be alarmed at the modes of diſcipline which are hereafter deſcribed, and even approved; nor perſuade themſelves to think that they

are incompatible with the finer feelings, and unjuſtifiable on the principle of ſport*. They are but means to prevent a greater evil; the natural faculties of the dog muſt be trained to their proper object and purpoſe; he is by nature wild and depredatory; he will ſometimes return to his natural hankering; and we venture to pronounce that the *man of feeling* would, at the ſight of ſheep worried in the fold, and of pigs and poultry in the farm-yard, acknowledge the truth of the old adage, and follow its dictates, " of two evils to chooſe the leaſt:" and were he either in the ſituation of the owner of the dog, or the ſufferer by his actions, he would equally countenance the ſeverities alluded to, and acknowledge them to be ſalutary modes for the correction and prevention of ſuch vicious habits.

There is however one circumſtance, relating to the economy of this animal and his dependance on man, which would honourably engage the feelings and the know-

* Vide Monthly Review for June 1790.

ledge of thoſe capable, by profeſſional education, to undertake the taſk ; we mean, an inveſtigation of the various diſeaſes to which dogs are ſubject (we ſay *various*, becauſe we do not ſubſcribe to that old but erroneous judgment which calls every diſorder with which a dog is afflicted, by the general name of the *diſtemper*), and thereby to form a rational ſyſtem of treatment. It is really ſurpriſing that no one has hitherto attempted this humane office; to many we are convinced it might be extremely eaſy. The whimſicality and rage of the preſent hour furniſh us with a variety of bombaſtic writers and treatiſes upon the means of *prevention*, as well as the method of *curing* diſeaſes incidental to horſes : it has alſo, in a lucky hour, given birth to a *ſociety* or *college* of *Veterinarians*, inſtituted for the expreſs purpoſe of improving the art of farriery, and to this end, ſoliciting communications from all the world, of any important information or uſeful diſcovery which may conduce to the improvement and extenſion of that branch of ſcience. As a ſportſ-

man, may we not be permitted to ſay, that the horſe is not a more uſeful nor a more noble animal than the dog? For the ſake of humanity, then, and for the enlarging of knowledge, we recommend and intreat this reſpectable and promiſing uſeful ſociety to extend their plan, and to invite communication on the nature and cure of the diſeaſes to which this worthy and affectionate creature is peculiarly ſubject, and ſubject, we are ſorry to ſay, at this time, without any one rational mode of treatment for the alleviation of pain, or the removal of complaint. For him, a ſmall ſpace of time intervenes between the adminiſtration of the moſt violent improper and inapplicable remedies, and the more humane but ſtill brutal one of the *rope*. Thus is a period barbarouſly put to his various miſeries, and thus is he, to the laſt, *treated as a dog*.

We are perſuaded that the diſeaſes of dogs are generally produced by the little care taken of them, and this at leaſt may be eaſily remedied.

But to return from this digreſſion, which

we moſt ſincerely hope will have the effect intended, to the matter of which we have profeſſed to treat, we have once more to ſolicit the candour of our readers towards the inſtructions we ſhall lay down, again availing ourſelves of our former allegation, that we do not in this part of the work write for *finiſhed* ſportſmen, but only for the *noviciate*. To the gentleman who may chooſe to train his own dog, we flatter ourſelves the general modes hereafter deſcribed will be uſeful; the dog-breaker by profeſſion can gain no new information from it; nor do we think that the former can, by the cloſeſt obſervation of them, attain to teach his dog ſuch nicety and accuracy of *manège*, that he can pretend to vie with the dogs of thoſe days when ſportſmen ſhot their game * *jet*, and when the dog was trained to be obedient to the almoſt imperceptible whiſper, to the ſlighteſt motion of the hand, and comprehended every thing that was required of him without the need of a ſingle

* Vide the Introduction.

word being ſpoken to him: at that time the dog was an agent abſolutely neceſſary to the ſucceſs of the ſportſman. But, at preſent, when volant wings cannot ſave the birds from the mortal ſhot, and when quadrupeds can no longer enſure ſafety by the fleetneſs of their courſe, a dog with all this addreſs is only a ſecondary conſideration; and the ſportſman who is not very ambitious on the one hand, or very blood-thirſty on the other, may poſſibly be content with a pointer formed and educated under the rules we have preſumed to lay down.

Three ſpecies of dogs are capable of receiving the proper inſtruction, and of being *trained*. Theſe are, the ſmooth pointer, the ſpaniel, and the rough pointer. The laſt is a dog with long curled hair, and ſeems to be a mixed breed of the water-dog and the ſpaniel*. The ſmooth pointer is

* Spaniele, index, or the ſetter: they are called Engliſh ſpaniels; whence it is probable, notwithſtanding the derivation of the name, that they are natives of Great Britain.—The pointer is a dog of foreign extraction, and was unknown to our anceſtors.

active, and lively enough in his range, but in general is proper only for an open country.

The greateſt part of theſe dogs are afraid of water, brambles, and thickets; but the ſpaniel and the rough pointer are eaſily taught to take the water, even in the coldeſt weather, and to range the woods, and rough places, as well as the plain. Greater dependence may therefore be had on theſe two laſt ſpecies of dogs, than on the ſmooth pointer.

Before you begin to break in a dog, it will be proper, when he is only five or ſix months old, to teach him to *fetch* and *carry*, which may eaſily be done without going out of the houſe, by means familiar to every one. With patience and gentle treatment, if the dog is of a good breed and diſpoſition, he will acquire the habit very eaſily; but much gentle uſage is neceſſary at this time, and if the dog ſhould be obſtinate in learning his leſſons, ſeverity and correction ſhould be carried only to a certain point. Therefore, as you perceive him to be diſheartened, let

let him reſt, beſtow careſſes on him, and return to the taſk another time.

If, however, this taſk cannot be accompliſhed by mild treatment, you muſt wait until the dog is of a proper age to be regularly trained; for then, in caſe of great obſtinacy, he will be able to bear the ſtrong collar, and thoſe other modes of diſcipline, which will be hereafter deſcribed.

It will, at the ſame time that you teach the dog to fetch and carry, alſo be proper to give him the firſt principles of obedience; which may be accompliſhed by walking with him a little diſtance from the houſe, and there learning him to come in, when he runs too far off; and to go behind when he returns; uſing in the firſt caſe the words, *here, come in*; and in the latter, *back*, or *behind.*

It is alſo highly neceſſary to accuſtom the dog, at this period, to be tied up in a kennel or ſtable, where you ſhould be careful to renew his ſtraw frequently.

But in theſe firſt eſſays, he ſhould not be kept tied up too long, in conſideration of his tender age, which ſeems to require ſome

 indulgence;

indulgence; he ſhould, therefore, be let looſe in the morning, and faſtened up again in the evening. Dogs which are not early accuſtomed to be chained up, diſturb you with their howling.

It is alſo of importance, that the perſon who intends to train him, ſhould alone ſpeak to and command him, and that none other ſhould interfere with his education, or give him his food.

When the dog has attained the age of ten or twelve months, it will be high time to carry him into the field, for the purpoſe of regular training. At the firſt you may let him do as he likes, without requiring any thing of him, the firſt ſtep being only to make him know his game. He will, at this time, run after every thing that he ſees; crows, pigeons, thruſhes, ſmall birds, partridges, hares. This eagerneſs being ſomewhat abated, he will end by only purſuing the partridge and hares, to the former of which his natural inſtinct will more particularly attach him; and being ſoon tired with following after theſe in vain, he will be

be content, after having flushed the birds, to follow them with his eyes.

He will not, however, do the same with hares; for seeing that they have but legs like himself, and do not leave the ground as partridge, he perceives that there is more equality with himself, and will not relinquish the hope of overtaking them: for this reason, he will continue the practice of running after hares, until corrected by education; and even then, it is very difficult to prevent the most crafty and best-trained dog, from pursuing hares.

All young dogs are subject to *rake*, that is, to hunt with their noses close to the ground; a habit, which you should not suffer them to contract, and of which you should effectually break them betimes, if it is possible to be done; for a dog that rakes with his nose, and follows the game by the track, will never make a good pointer, nor find half so much game, as one that hunts with his nose high. Whenever, therefore, you perceive that your young dog is following the track of partridge down wind,

call

call to him with an angry tone, *hold up*; he will then grow uneaſy and agitated, going firſt on one ſide, and then on the other, until the wind brings him the ſcent of the birds. He will only have to find the game four or five times in this way, when he will take the wind of himſelf, and hunt with his noſe high.

Yet, there are dogs which it is almoſt impoſſible to break of this fault, and ſuch are ſcarcely worth the training. The beſt method to be uſed with a dog of that deſcription is, to put the *puzzle peg* upon him. This is an inſtrument of a very ſimple conſtruction, being no other than a piece of oak or deal inch board, one foot in length, and an inch and a half in breadth, tapering a little to one end; at the broader end are two holes, running longitudinally, through which the collar of the dog is put; and the whole is buckled round his neck; the piece of wood being projected beyond his noſe, is then faſtened with a piece of leather thong to his under jaw. By this means, the peg advancing ſeven or eight inches beyond his ſnout,

ſnout, the dog is prevented from putting his noſe to the ground and raking.

This inſtrument is alſo proper for dogs that tear the game; and ſometimes has been found to make a dog that is too eager, and poſſeſſing the bad habit of running up to the foremoſt dog in the point, ſtand better in company.

Partridges lye much better to dogs which *wind* them, than to thoſe that follow them by the track. The dog that winds the ſcent, approaches the birds by degrees, and that, more or leſs, as he finds them either ſhy or tame, or, in other words, whether they will lye well, which he is enabled to know by the ſcent which they emit, when they are uneaſy; and notwithſtanding they ſee him hunt round about them, they will not be alarmed, becauſe they do not perceive that he is following them.

Nothing diſturbs the birds more than their ſeeing a dog tracing their footſteps, and keeping the ſame courſe that they are taking to ſteal off; and when a dog follows them in this manner down wind,

it

it moſt commonly happens that he fluſhes them ; or if, by accident, he makes a point, it will probably be much too near the birds; for, in going down wind, he cannot take the ſcent until he is almoſt upon them, and then they will not lye.

As ſoon as the young dog knows his game, you muſt bring him under complete ſubjection and command. If he is naturally tractable, and has profited from the inſtructions you have given him, before his being taken into the field, it will be eaſy to accompliſh it ; but if he is ſtubborn and unruly, it will be neceſſary to make uſe of the *traſh cord*.

This is done by only faſtening to the collar of the dog, a rope or cord, of about twenty or twenty-five fathom in length, and then letting him range about with this dragging on the ground. By the help of this cord, you will be able to keep him in, whenever you call to him, which you ſhould never do but when you are within reach of it ; and then, if he ſhould continue to run forward, you muſt check him ſmartly with the

the cord, which will often bring him upon his haunches. When you have repeated this a few times, he will not fail to come in immediately on being called; you ſhould then careſs him, and give him a bit of bread, and continue to do ſo, whenever he comes in on being called to.

After this, in order to accuſtom him to croſs and range before you, turn your back to him, and walk on the oppoſite ſide; when he loſes ſight of you, he will come to find you, he will be agitated and afraid of loſing you, and will, in ranging, turn his head from time to time, to obſerve whereabouts you are. Eight days practice of this manœuvre, will make him range on whatſoever ſide you pleaſe, by only giving him a ſign with the hand.

When the dog is arrived at this point of inſtruction, be careful to keep him conſtantly tied up; never unchain him but when you give him his food, and not always then, but at thoſe times only, that he has done ſomething to deſerve it.

The next ſtep will be to throw down a

piece

piece of bread on the ground, at the ſame moment taking hold of the dog by the collar, calling out to him, "*take heed*;" "*ſoftly*." After having held him in this manner for ſome ſpace of time, ſay to him, "*ſeize*," "*lay hold*." If he is impatient to lay hold of the piece of bread before the ſignal is given, correct him gently with a ſmall whip. Repeat this leſſon until he "*takes heed*" well, and no longer requires to be held faſt to prevent him from laying hold of the bread. When he is well accuſtomed to this *manège*, turn the bread with a ſtick, holding it in the manner you do a fowling piece, and having done ſo, cry, "*ſeize*."

Never ſuffer the dog to eat either in the houſe or field, without having firſt made him "*take heed*" in this manner.

Then, in order to apply this leſſon to the game, fry ſmall pieces of bread in hogs lard, with the dung of partridge; take theſe in a linen bag into the fields, ſtubbles, ploughed grounds, and paſtures, and there put the pieces in ſeveral different places, marking the ſpots with little cleft pickets

of

of wood, which will be rendered more diſtinguiſhable by putting pieces of card in the nicks. This being done, caſt off the dog, and conduct him to theſe places, always hunting in the wind. After he has caught the ſcent of the bread, if he approaches too near, and ſeems eager to fall upon it, cry to him in a menacing tone, "*take heed*;" and if he does not ſtop immediately, correct him with the whip. He will ſoon comprehend what is required of him, and will ſtand.

At the next leſſon, take your gun charged only with powder, walk gently round the piece of bread once or twice, and fire, inſtead of crying "*ſeize*." The next time of practiſing this leſſon, walk round the bread four or five times, but in a greater circle than before, and continue to do this, until the dog is conquered of his impatience, and will ſtand without moving, until the ſignal is given him. When he keeps his point well, and ſtands ſteady in this leſſon, you may carry him to the birds; if he runs in upon them, or barks

when they ſpring up, you muſt correct him; and if he continues to do ſo, you muſt return to the fried bread: but this is ſeldom neceſſary.

There are many dogs that will point the firſt day they are taken out, and there are others which will both point and back the firſt time, by natural inſtinct. But to make the dog ſtaunch, you ſhould endeavour to kill a few birds on the ground before him, and ſhould not ſhoot flying, until he is well trained, and ſteady. This, however, can only be done when the dog is broke in during the ſhooting ſeaſon.

The ſpring is the beſt time for training dogs; becauſe the birds being then paired, lye better, and being ſprung more ſeldom, and in fewer number, the dog is not ſo ſubject to be eager, and is kept under command with greater eaſe. But as this ſeaſon ſcarcely allows time to make the dog perfect and ſtaunch, you muſt reſume his leſſons in the month of September, or the latter end of Auguſt, which will ſoon complete him.

Another method uſed to break in a dog, is, with a cord of the ſame length as the former, and the ſtrong collar. This collar is made of a ſtrong leather ſtrap, and ſtuck with three rows of ſmall nails, the points of which extend three or four lines of an inch beyond the ſurface of the inſide; a ſtrong piece of leather is then put over the heads of the nails, on the outſide of the collar, in order to prevent their ſtarting back, when the dog preſſes upon the points. A ring is faſtened to each end of this collar, for if it was buckled like a common one, it would perpetually wound the dog; through theſe rings, therefore, is paſſed one end of the cord, in ſuch a manner, that in pulling towards you, the rings bring the collar cloſe; the nails then preſs upon his neck, and warn him of his fault.

As ſoon as the dog is inſtructed to "*take heed*" of the bread, in the way before explained; you muſt carry him into the fields, with the ſtrong collar on his neck and the traſh-cord dragging on the ground; be careful not to let him range too wide,

but keep him within ſuch a diſtance, that you can always lay hold of the cord, at thoſe times, when it may be neceſſary to check him.

When the firſt birds are ſprung to the dog, if he runs after them, or barks, give him a few checks, calling out to him, " *take heed.*" If he ſtands at them, then careſs him; but you ſhould never hunt him without the cord, until he points ſtaunch.

When once a dog is taught to point at partridges, he will ſtand at every ſort of winged game, and even at hares; yet as before remarked, it is very difficult to prevent dogs from running after hares, whether they ſtart at a diſtance or after the dog has pointed them; eſpecially if he is at ſome diſtance from his maſter, who will, in that caſe, try in vain to make him come in; for, when a dog perceives his maſter a good way off, he will not ſo readily obey his voice, as when he is near him. It is not eaſy to correct dogs of this fault (if it may be accounted ſuch), except in places where there are many hares, for

there,

there, by feeing them frequently, he gets tired of purfuing them. Befides, to keep a dog in the habit of not running after hares, he muft be hunted only in open grounds; for, if you once carry him into a wood, he will be certain to run after both hares and rabbits, and then when you return to the open fields, he will do as he did in the wood.

There are few dogs that will not fometimes break in upon the birds, particularly when hunting down wind; you fhould therefore, when he does fo, only fpeak roughly to him, and not chaftife him, unlefs, indeed, he runs after the birds; in that cafe, mark the place from which they got up, for the dog will foon return thither, and then you muft chaftife him with the whip; but with moderation, which is always neceffary, and particularly fo, if the dog is timid.

There are dogs of this nature, which, if you beat them exceffively, will lye down at your feet, and will hunt no more: others again leave you and run home. In the

last case, one mode of correction is, to have a stake fixed in the middle of the yard, furnished with a chain and collar; when the dog arrives, a servant previously instructed, should fasten him to the stake, and give him a sound beating, which should be repeated at intervals, for the space of an hour. During this operation, the master should not appear, but remain without shewing himself, until some time after the last correction, in order that the anger of the dog may have time to subside. Then he should go up to him, caress him much, unchain him, give him some food, and afterwards carry him back to the field. However, this mode is not so infallible as many have asserted; for it often happens, that the dog who has thus received the strappadoes, the next time he arrives at the house, after having run away, slinks off, and lurks in some hole, without your knowing what is become of him, and does not make his appearance again for a long while.

The best way is, to study the temper and disposition of the dog, and to conduct your-

self

ſelf accordingly in the application of correction.

We have before ſaid, that when you cannot ſucceed in teaching a dog his firſt leſſons at an early age, by gentle treatment, it is neceſſary to wait until he is older, and then to make uſe of the ſtrong collar; here then is the beſt mode of uſing it. Take a ſquare piece of wood, of about eight or nine inches in length, and one inch in thickneſs, cut notches on the edges like the teeth of a ſaw, and bore two holes at each end, in order to fix two ſmall pegs croſs-wiſe, ſo that when this piece of wood is thrown on the ground, the pegs may ſupport and raiſe it above the ſurface a full inch, the purpoſe of which is, to enable the dog to mouth it the more eaſily. The ſtrong collar ſhould then be put about his neck, and taking the ſtick, rub the notches backwards and forwards on his teeth, to make him open his mouth; but do it gently, to hurt him as little as poſſible: when he has taken it into his mouth, hold your left hand under his chaps, in order to prevent his putting it out, and with the right

carefs and pat him, crying "*take heed.*" If, when you take away your hand from under his mouth, the dog lets fall the ftick, fpeak harfhly to him ; and check the collar to chaftife him ; then make him take the ftick in the fame manner as before. The dog thus perceiving that he is punifhed when he drops the ftick, and careffed when he retains it, will at length accuftom himfelf to hold it, and will open his mouth when you prefent it to him. You muft then proceed to make him take it himfelf, by prefenting it to him, crying at that inftant, "*lay hold* ;" at the fame time, you fhould carefs him much, and now and then give him little checks, to make him more alert, and come forward more expeditioufly.

If, in practifing this leffon, the dog advances of his own accord, and takes the ftick, carefs him again, and give him a little bit of food. When he begins to put forward his head an inch or fo, he is then fufficiently broken in to this manœuvre, and will foon take the ftick from the ground, in doing which you muft firft fay to him very loud, "*lay*

"*lay hold,*" and afterwards, "*bring here.*" In order to habituate the dog in this exercise, when he is advanced ſo far as to bring the ſtick readily, you ſhould ſometimes ſubſtitute in the place of the piece of wood, the wing of a partridge, ſewed upon a linen cuſhion, and at other times the ſkin of a hare ſtuffed with hay, in each end of which you ſhould put a ſtone, to accuſtom him to carry a hare by the middle of the body. At length when he brings every thing readily to you, carry him into the field, and make him bring the firſt bird that you kill to you; if he requires much entreaty, put the ſtrong collar on him, which, in caſe of need, you ſhould carry along with you.

To teach the dog to take the water, chooſe a pool, the edges of which gently decline; throw a piece of wood into it, at firſt but to ſo ſmall a diſtance from the ſide, that he may be able to reach it by only wading to his mid-leg. Afterwards increaſe the diſtance by degrees, until he ſwims to take it; be careful at each time that he brings

the piece of wood to you, to give him ſomething to eat. If he will not venture to ſwim, you muſt take another courſe; carry him to the pool before he has breakfaſted, and throw pieces of bread into the water, gradually increaſing the diſtance as before, and by this method, you will ſoon teach him to earn his breakfaſt by ſwimming.

To complete this training, if you have a piece of water of ſufficient depth, put a wild-duck into it with the wings cut, then animate and encourage the dog, until he goes into the water to follow the duck, which will ſwim before him, and ſometimes dive when followed cloſe, in order to diſengage herſelf from the purſuit. When this *manège* has laſted ſome time, finiſh it by ſhooting the duck, and the dog will not fail to bring it to you very readily. Theſe leſſons, however, ſhould be given in warm weather, for you will ſcarcely prevail on any dog to go into the water in winter; even the attempt alone might give him a dread

dread of it; but at all events, if he refuſes to take the water, you ſhould never throw him in.

The ſportſman has only to conduct himſelf with patience and moderation, and obſerve the rules here laid down, and he will accompliſh his work.

To make a dog *back*, and ſtand in company, you ſhould hunt him with an old ſtaunch dog; and then, with a ſmall application of the principles of training, you will eaſily effect this neceſſary qualification.

Young dogs, for the moſt part, love to run after poultry, and ſome after ſheep; theſe are faults which it is abſolutely neceſſary to correct betimes. As to the poultry, if you cannot make your dog leave off the cuſtom of chaſing them, by the virtue of the whip, the following method will do it. Take a ſmall ſtick, cleft at one end ſufficiently wide to admit the tail of the dog, which being introduced, tie the cleft end with a piece of twine tight enough to make him feel pain; at the other end of the ſtick tie a fowl by the wing; then after a little

time, let the dog loofe, at the fame inftant giving him a few heavy ftrokes with a whip. The dog will then run as faft as he can, by reafon of the pain in his tail, which he imagines is caufed by the fowl. By dint of dragging the fowl, he will kill it, and, fpent with running, he will ftop, and afterwards hide himfelf in fome hole; then take off the ftick, and beat him about the mouth and head with the dead fowl.

If the dog runs after fheep, and you cannot break him of the cuftom, couple him with a ram, and in letting them loofe, whip the dog as long as you can follow him. His cries will at firft alarm the ram, who will run with all his fpeed, and drag the dog along with him; but he will foon take courage, and will end with butting the dog moft feverely. When you think the dog has received fufficient correction, uncouple him, and he will never run at fheep again.

CHAP. XVII.

The Game.

THAT the preſent work may be of general utility, we will, in the laſt place, proceed to treat, though not diffuſely, of the various ſpecies of game, and of a few of thoſe other birds and animals, which afford the diverſion of ſhooting in England. And, that the ſubject may be productive of entertainment, as well as inſtruction to the ſportſman, we will alſo add deſcriptions of ſome few particular methods of approaching thoſe objects of ſport; not ſuch as are in general knowledge and practice, but thoſe only, which from their ſingularity, as well as excellence, are worthy of note; avoiding any account of thoſe various devices that man has invented to deceive the continual vigilance which animals in a ſtate of nature

oppoſe to his ſnares, and which, in the preſent refined ſtate of ſporting, are wholly confined to the practice of a ſet of gentlemen denominated *poachers*.

THE HARE

IS of all the animals hunted with hounds, that which beſt defends itſelf by the exerciſe of cunning. The chaſe alſo of this little creature, is not only leſs expenſive, but more intereſting and agreeable than any other.

Without making mention of her ordinary ſhifts, ſuch as getting up into the hollow ſtump of a tree, or upon the walls of an old ruin, we will juſt obſerve, that the hare has been known, after having made ſeveral doubles, to ſquat down until the dogs and horſemen have paſſed by, then to take the back ſcent, and return upon that track which the hounds have purſued.

Another has been known, after doubling many

many times in a marſh near the edge of a river, to throw herſelf into the water, float down with the ſtream the length of 500 paces, and then to get upon a little iſland.

A third has been known to ſwim into the middle of a piece of ſtanding water, keeping only her noſe above the ſurface in order to draw breath *.

Theſe are matchleſs efforts of cunning.

According to naturaliſts, the hare lives ſix or ſeven years, and attains its full growth in one. From the firſt year it engenders at all ſeaſons, and has no particular time for coupling with the female. Yet, it is obſervable, that from the month of December to the month of March, the buck ſeeks the doe more frequently, and about that time the greateſt number of leverets are found. The doe goes with young thirty, or one-and-thirty days, and brings forth one, two, three, and ſometimes four young ones,

* The doubling of the hare, before ſhe goes to her form, thereby to dodge and deceive the dogs, is a remarkable inſtance of the natural ſagacity of this animal for purpoſes of her ſecurity.

which

which ſhe kindles in a tuft of graſs or heath, or in a little buſh, without any preparation whatever.

When there are ſeveral leverets at a birth, it is ſaid that the whole are invariably marked with a ſtar on the forehead, and when there is but one, it is alſo ſaid that it never has this mark.

Several authors of natural hiſtory have aſſerted, that all, or the greateſt part of hares, were hermaphrodites. We are aſtoniſhed to find it advanced in one book (amongſt many others), which treats of modern ſport *, "*That the male hare engenders in its own body, but never brings forth but one leveret.*"

It is remarkable alſo, that the ancient *Leges Wallicæ* affixed no fine for the killing of a hare, for this ſingular reaſon, that it was believed every other month to change its ſex.

The circumſtance which ſeems to have given riſe to this ſtrange conjecture, is the

* Nouveau Traité de Venerie par Clement de Chapville, Paris, 1742.

formation

formation of the genital parts of the male hare, whofe tefticles do not appear on the outfide of the body, efpecially when he is young, being contained in the fame cover with the inteftines. Another reafon is, that on the fide of the penis, which is fcarcely to be diftinguifhed, there is an oblong and deep flit, the orifice of which much refembles the *vulva* of the female. This equivocal conformation makes it difficult to know the fex of hares by the infpection of the genital parts; fportfmen therefore feldom refer thither in order to diftinguifh the male and female, but refort to other marks, which point them out more eafily. Thus the head of the male is more fhort and round, the whifkers longer, the fhoulders more ruddy, and the ears fhorter and broader, than thofe of the female; the head of which is long and narrow, the ears long and fharp at the tip, the fur of the back of a grey colour inclining to black, and, in point of fize, is larger than the male.

The male hare, or buck, when he is hunted with hounds, after making one or

two

two rings, generally runs ſtraight forward; he goes a great way, and makes a long chaſe. The doe runs leſs, ſhe dodges about the place ſhe inhabits, and more frequently doubles.

When a hare is eſpied on the form, if the manner in which the ears lie, is obſerved, it may be known whether it is a buck or doe. If a buck, the ears will be drawn cloſe upon the ſhoulders, one againſt the other; but if a doe, the ears will be open and diſtended on each ſide of the neck and ſhoulders.

Two ſpecies of hares may be diſtinguiſhed; thoſe of the wood, and thoſe of the plain.

The hares of the wood are, in general, much larger than thoſe of the open ground, their fur is not of ſo dark a colour, and they are better covered with it; they are alſo ſwifter in the chaſe, and their fleſh is of a better flavour.

Among the hares of the plain, thoſe may be diſtinguiſhed which inhabit the marſhes. They are not ſo ſwift of foot, they are leſs covered

covered with fur, and their fleſh is not ſo fine and delicate.

A young hare that has attained the full growth, is known from an old one, by feeling the knee-joints of the fore-legs with the thumb-nail. When the heads of the two bones which form the joints, are ſo contiguous, that little or no ſpace is to be perceived between them, the hare is old. If, on the contrary, there is a perceptible ſeparation between the two bones, the hare is young, and is more or leſs ſo, as the two bones are more or leſs ſeparated. It may alſo be known whether a hare is young or old, but without pretending to aſcertain the preciſe age, by compreſſing the under jaws: if they break at the point immediately under the fore teeth upon a ſlight degree of preſſure, the hare is certainly a young one; but if conſiderable force is required, the contrary is as certain.

But as ſhooting, or otherwiſe deſtroying hares, although an amuſement much admired by the ſportſmen of other kingdoms, yet in this is practiſed only by poachers,

and is even doubted by ſome to be permitted by the exiſting game-laws; we will purpoſely omit all deſcription on that head, and content ourſelves with giving one hint on the ſubject.

If the ſportſman wants to come near a hare which he has eſpied upon the form, he muſt not go towards her in a ſtraight line, but approach circularly, otherwiſe ſhe will ſtart up.

As the reaſon for omitting a detail of the methods practiſed for approaching hares, in order to ſhoot them, does not extend to rabbits, our information regarding them ſhall be more extenſive.

THE RABBIT.

EVERY one knows the prodigious fecundity of this animal, particularly of the tame ones, the females of which bring forth almoſt every month in the year. Among thoſe of the warren, of which alone we ſpeak

ſpeak here, the doe brings forth only five or ſix times in the year, each litter conſiſting of four, five, and ſometimes ſeven young ones. When ſhe is about to kindle, ſhe ſcratches, in the burrow ſhe inhabits, a ſmaller one, of only two or three feet in depth, for the purpoſe of keeping from the buck the knowledge of her young ones, fearing that he would kill them*. She frequently kindles at a conſiderable diſtance from her own burrow, and ſometimes out of the warren, in the open country. At the bottom of this excavation, which by warreners is called the *rabbit's neſt*, ſhe prepares a bed for her young, compoſed of the fur which ſhe pulls from her belly, and a few blades of graſs. Here ſhe ſuckles and attends them, for the ſpace of ſix weeks. It is pretended, that, whenever ſhe goes out

* The male rabbit has the ſame unnatural diſlike to its offspring as the Arctic black bear and ſome other animals have, they will kill the young ones; the female therefore retires before the time of parturition into ſome ſecret place, to elude the ſearch of her ſavage mate.

PENNANT.

of her neſt to procure food, ſhe, in order to preſerve her young from the depredations of vermin, ſtops up the mouth of the hole with earth diluted with her own urine.

At the expiration of ſix weeks, ſhe conducts her young ones to the great burrow, for in this time they are in no danger from the male, who then careſſes them, takes them between his fore feet, and licks their fur ſmooth with his tongue.

An old rabbit is diſtinguiſhed from a young one by the ſame ſigns which we have before deſcribed in ſpeaking of the hare.

No ſport is more pleaſant and eaſy than that of hunting rabbits with one or two terriers, in a warren which is tolerably well ſtocked; eſpecially, if the terriers are wry legged. For, in that caſe, the rabbits only play before the dogs, ſtopping at each inſtant to liſten to them, and ſuffering themſelves to be driven about ſometimes for the ſpace of three quarters of an hour before they take the burrow. Then as theſe ani-

mals run about in a ſmall compaſs, it is very eaſy to come in their way, either in the paſſes, or the ſides of the woods, by following the cry of the dogs; or elſe by waiting for them at the burrows, about which they generally play for ſome ſpace of time, before they take the earth.

The rabbit is very timid, and very acute of hearing; for which reaſon, care ſhould be taken to make as little noiſe as poſſible; and in particular, never to walk or run in the paſſes or acroſs the woods to get before them, but at thoſe times only when the dogs give tongue; for then the rabbit, being occupied either with liſtening to the dogs or running before them, pays leſs regard to the noiſe which the ſportſman makes in the purſuit.

In a warren of ſmall extent, much amuſement may be procured by ſtopping up all the burrows at midnight, at which time the rabbits are almoſt all out at feed, and then going to hunt them the next morning; by thus cutting off their retreat, a man cannot

fail to kill feveral. Or, he may ftop up the burrows with hay, grafs, or any other material, at the diftance of two feet from the mouth downwards, and then when the rabbits are driven in with the dogs, he may take as many as he pleafes.

Rabbits are hunted with dogs, at all times of the year; but the months of July and Auguft are the moft favourable; they then abound, and are of a good fize; fome have attained their full growth, and the fmalleft are half grown; earlier than this they are fcarcely worth the trouble of fhooting, and the dogs hunt them badly, becaufe they do nothing but dodge about little bufhes, not being in a condition to defend themfelves.

Skill and practice, but above all quicknefs, are eminently neceffary to fhoot rabbits in a wood, either when the rabbit is hard run by the dogs, or at the moment of ftarting up, or in a view; and ftill more fo, when purfued by a fpaniel who has ftruck at but miffed her. If at this time the

the rabbit croſſes a road, or a paſs cut through a wood, ſhe darts like lightning, and ſcarcely gives the ſhooter time to prepare himſelf, unleſs the way is very broad.

It is alſo very difficult to ſhoot her when ſhe gets up from among his feet, whether in a wood, or in places covered with heath or brambles which adjoin the warren, and where they are moſt commonly found. The courſe of a rabbit for ſome little time at the firſt, is much more rapid than that of the hare, and is at the ſame time oblique and twiſting. It ſeems to glide rather than run, and the proper moment of ſhooting is not eaſily ſeized.

There are many other ways of killing rabbits, of which lurching is in moſt common uſe. This ſucceeds beſt in fine weather, and at thoſe times when the young rabbits are in abundance.

If at any time of the day, but principally from nine in the morning until noon, and again in the evening, about ſunſet, the ſportſman poſts himſelf near ſome well-frequented burrows, either by getting up

into a tree, or lying behind a hedge, he will ſoon ſee them come out of their holes and play about the edges, at which time he may ſhoot them to great advantage. Or he may in the evening watch thoſe pieces of corn-land which lye near the warren; for thither the rabbits are certain to go at that time to feed.

Rabbits, being accuſtomed to run about much during the night, may be ſhot by moonlight, by watching at thoſe places where they come to play or feed.

Or a ferret may be put into the burrows, and the rabbits ſhot as they bolt out; but this is ſo rapid a motion that great quickneſs of ſhot will be neceſſary.

PARTRIDGE

PAIR in the ſpring, but at an earlier or later period, in proportion as the ſeaſon is more or leſs mild. When the weather in egisal in the month of January they are found

found in pairs, but then, if the cold weather returns, they again form in coveys.

The hen partridge lays her eggs during the whole of the month of May, and the beginning of June. Her neſt is made upon the ground, and conſiſts only of a few blades of graſs, conſtructed without art, either at the edge of a corn-field, in a meadow, a heath, &c. She lays from fifteen to twenty eggs.

The earlieſt birds begin to fly towards the latter end of June. From this ſtate of growth their plumage undergoes a variety of changes, until the period arrives when the red and blackiſh feathers begin to form the *horſe-ſhoe* upon the breaſt, which is very conſpicuous on the male, but leſs diſtinguiſhable on the female: this mark takes place about the beginning of October, and it is not until that is perfect that they can properly be called *partridges.*

The young birds at this time, when the plumage is complete, can only be diſtinguiſhed from the old ones by the firſt feather of the wing, which terminates in a point

point like a lancet, whereas in thofe which are not of the laft brood, this feather is round at the extemity.

This diftinction remains until the firft moulting, which generally takes place in the July following. A further difference is alfo obfervable in the colour of the legs, which in the young ones are yellow, and in the old grey.

The difference between the male and the female, when the partridge have attained their full growth, confifts in the horfe-fhoe, which we have before noticed, and in an obtufe fpur on the hinder part of the leg; the male only has this protuberance, and he is befides a little larger than the female.

Partridge are not equally abundant every year; their number depends in a great meafure upon the mildnefs of the weather, not only at the time of laying the eggs, and the feafon of incubation, but alfo, when the birds are hatched: this period of time is, for the moft part, from the end of April, to the middle of June.

In general, when the feafon is dry at this period,

period, the birds are very numerous. But on the contrary, when the rains have been heavy and frequent during the time of laying and incubation, the neſt, which the partridge prefers to make in low places, is deſtroyed by the floods; an event which would not probably have happened, if the rains had ſet in ſooner; for in that caſe, the partridge finding the plains and low places too wet, would have choſen to build her neſt in a dry elevated ſituation. If the rains happen at the time when the young birds come out of the ſhell, many of them, which have ſcarcely ſtrength at that time to ſtand, will be drowned. A wet ſeaſon alſo deſtroys the ants, which are the chief food both of young partridges and pheaſants. At ſuch time even drought, when it is in a certain degree, is unfavourable to them, for then the ground cracks, and forms crevices, into which they fall and periſh; being too weak to extricate themſelves.

The old partridge has alſo many dangers to encounter, from the time of laying her eggs until the young ones are hatched;

and theſe ariſe as well from weazels and other vermin, crows, magpies, and ſhepherds dogs (all of which ſuck the eggs), as from the ſhepherds and farmers themſelves, who deſtroy the eggs. So that, except in thoſe manors which are well preſerved, there is reaſon to ſuppoſe, that one half of the broods in any one year, are never reared.

When the eggs of a partridge are deſtroyed in any of theſe ways, it ſometimes happens that ſhe lays again; therefore, when at the end of September, and even later than that, young birds are found not perfectly feathered in the tail, they are of this ſecond hatching, or as it is ſometimes termed "*clacking*."

Whilſt the birds are young, that is to ſay, until the middle of October, it is eaſy to ſhoot them, in a country tolerably well ſtocked; but after that period, and eſpecially when they have taſted the green wheat, they fly far and are very wild; they are not to be ſeparated but by dint of following them down, particularly in a flat country, where there are neither roughs nor

thickets;

thickets; and it is only by breaking the covey that we can indulge a reaſonable hope of ſucceſs; for while they remain in the covey, we can ſcarcely get within gunſhot of them. Thus, it is more eſſential in this ſport, than in any other, that the ſhooter ſhould have good legs and eyes: the legs, to tire the birds and break the covey, by an inceſſant purſuit; and the eyes, to mark them down with certainty.

When a ſportſman is ſhooting in a country where the birds are thin, and he no longer chooſes to range the field, for the bare chance of meeting with them; the following method will ſhew him where to find them on another day. In the evening, from ſun-ſet to night-fall, he ſhould poſt himſelf in a field, at the foot of a tree or a buſh, and there wait until the partridge begin to call or "*juck*," which they always do at that time; not only for the purpoſe of drawing together when ſeparated, but alſo, when the birds compoſing the covey are not diſperſed. After calling in this manner for ſome little ſpace of time, the partridge will take a flight; then, if he marks

marks the place where they alight, he may be aſſured they will lye there the whole night, unleſs diſturbed. Let him return to the ſame poſt the next morning by break of day, and there watch a while; being careful to keep his dog in a ſtring, if he is not under perfect command.

As ſoon as the dawn begins to peep, the partridge will begin to call, and ſoon afterwards will perform the ſame manœuvre as on the preceding evening; that is to ſay, after having called a while, they will take their flight, and will moſt commonly ſettle at a little diſtance. There, in a few minutes they will call again, and ſometimes take a ſecond flight, but that will be to no great diſtance. Then, as ſoon as the ſun is riſen, and the ſportſman can ſee to ſhoot, he may caſt off his dog and purſue them.

In ſnow it is very eaſy to kill partridge on the ground before a ſetting-dog or pointer; becauſe the colour of the birds, contraſting with the whiteneſs of the ſnow, makes them perceivable at the firſt glance. Then the poachers have fine ſport, eſpe-

cially if the ſnow happens at the full of the moon. At this time they will be out the whole of the night, with ſhirts over their clothes, and white caps on their heads; and then, as the partridge lye in a cluſter, they frequently deſtroy half the covey at one ſhot. Thus, ſnow may be accounted the moſt fatal time for partridge; for if it laſts but a little while, they are expoſed to the wiles of the poacher, and if for a long time, they periſh with hunger.

As one-third more of male than female partridges are bred in a ſeaſon, it happens, that in the time of pairing, ſeveral cocks contend for the ſame hen, who being thus tormented, will ſometimes totally deſert the diſtrict; or if ſhe remains, being thus obliged to run continually about, in order to avoid the purſuit of the males, whom ſhe hath repulſed, ſhe drops an egg in one place, and an egg in another, until, at length, there remains for her but one cock, and no neſt.

It would therefore much increaſe the broods of partridge, to kill a part of the

cocks

cocks when they begin to pair; but as this could only effectually be done after the time limited for shooting them in this country expires, we must necessarily omit giving any instructions on the subject. There are, however, some few sportsmen in England, of such keen eyes, that they can distinguish the cocks from the hens, when the covey rises from the ground, and so expert, as to make it the pride of their dexterity, to kill not more than a brace of hens in one day's sport.

THE PHEASANT

IS of the size of a common dunghill cock. He is a superb bird, and, as Buffon says, may dispute the prize of beauty with the peacock himself, having a carriage as noble, a gait as proud and stately, and a plumage nearly as much distinguished. This of course is only to be understood as relating to the male, for the plumage of the hen has little splendour, and much resembles the quail,

quail, which makes them eaſy to be diſtinguiſhed in ſhooting, and prevents the killing a hen inſtead of a cock.

Theſe birds generally lay their eggs in the woods, the number of which is commonly ten or twelve. The ſeaſon of the young pheaſants, nearly correſponds with that of the partridge.

The pheaſants of the firſt year are marked in the wing like partridge. The young cock, whoſe plumage is completed the firſt year, is in like manner known by the ſpurs, which in him are round and blunt, but long and ſharp in the old one. The hen has alſo a ſmall ſpur on the hinder part of the leg, which is very ſmall in thoſe that are young, and larger and more prominent in the old; but this happens in a greater or leſs degree, in proportion to the age of the bird. Beſides, in the young ones, the ſpurs are ſurrounded each with a ſmall black circle, which does not diſappear until the ſecond hatching.

The legs of thoſe which are very old, that is to ſay, ſuch as have attained five or

ſix years, are more wrinkled, and of a darker colour than thoſe of the young ones in the firſt year; the cryſtal of the eye of the former is alſo more yellow, whilſt that of the young ones of the firſt and ſecond year is white. But all theſe marks and ſigns are not without many exceptions. The leaſt equivocal mark, perhaps, is the beak, which feels more tender in the young than in the old birds.

Pheaſants are accounted ſtupid birds; for when they are ſurpriſed, they will frequently ſquat down like a rabbit, ſuppoſing themſelves to be in ſafety as ſoon as their heads are concealed, and in this way they will ſometimes ſuffer themſelves to be killed with a ſtick. They love low and moiſt places, and willingly haunt the edges of thoſe pools which are found in woods, as well as the high graſs of marſhes that are near at hand; and, above all, places where there are clumps of alders.

The inſtinct of theſe birds is not of a nature ſo ſocial, as that of the partridge. As ſoon as they find that they have no further

further occaſion for the care of the hen-mother, they ſeparate from her, and live in ſolitude; ſhunning one another at all times, except in the months of March and April, the ſeaſon at which the male ſeeks the female.

During the day-time, pheaſants remain upon the ground among the underwood, from whence they frequently iſſue forth into the ſtubbles, and the fields lately ſown; but it is only in countries where they are in great plenty, that they thus ſhew themſelves in the open grounds. At ſun-ſet, the greateſt part of them fly up into the long branches of oak trees, in order to rooſt all night, and at the time they do this, they invariably make a noiſe, which is called "*cocketting*," and that in a greater degree during the winter ſeaſon; ſo that poachers who lye in wait for them in the evening, are warned by the noiſe of the place where they are perched, and, when the night is advanced, repair under thoſe trees which the birds have choſen, and there ſhoot them with the greateſt eaſe; for at this time the pheaſants

will permit them to come as near as they pleaſe, and will ſometimes even permit the poacher to fire more than one ſhot, before they will leave the tree.

The pheaſant is alſo frequently taken when thus perched upon a tree, by holding a lighted match directly under him, ſo that, the fumes of the ſulphur reaching him, he falls ſuffocated to the ground *.

THE GROUSE, OR MUIR-GAME,

ARE found in ſome parts of the northern counties of England, and in parts of Wales; but in neither of theſe countries are they at this day very numerous.

* Monſ. du Pratz in North America hit upon a very ingenious expedient for taking the paſſenger pigeon on the rooſt, by placing under the trees veſſels filled with flaming ſulphur; the fumes of which aſcending, brought them ſenſeleſs to the ground in perfect ſhowers. PEN. Arc. Zool.

In Scotland, however, and particularly in the vicinity of the Grampian mountains, they abound in ſuch ſort, that a tolerable ſhot may kill from twenty to thirty brace a day, for the firſt three weeks of the ſeaſon; provided the weather is favourable. An excurſion, therefore, into that country in the grouſe ſeaſon, affords the keen ſportſman a noble entertainment.

This ſpecies of ſport is ſo perfectly ſimilar, in all its operations, to that of partridge ſhooting, that it will be unneceſſary for us to ſay more on the ſubject, other than to ſubjoin a ſhort deſcription of the bird, and ſome of its habits.

The grouſe is larger than the partridge, and weighs about nineteen ounces. The plumage is a mixture of red, black, and white, and the tail is nearly ſimilar to that of the partridge, only a little larger. The legs are clothed with feathers to the very toes, and the outmoſt and inner toes are connected to the firſt joint of the middle toe by a ſmall membrane. The bill is ſhort, arched, and of a blackiſh colour, and the

eyes are encircled with two large and red eyebrows, which are compoſed of a fleſhy membrane, rounded and pinked on the upper part, and extending beyond the crown of the head.

The plumage of the hen has leſs of the red and more of the white than the cock, the membrane of the eyebrow is leſs projected, leſs pinked, and of a leſs lively red. She makes her neſt on the ground, and lays from eight to ten eggs.

The principal food of grouſe is the black whortle berry *(vaccinium myrtillus)* and the red whortle berry *(vaccinium vitis-idæa)*, alſo common heath berries. It is a cuſtom in Wales, to cut open the part which contains the food, for young ſportſmen to ſmell—the fragrance is accounted extremely fine.

The young birds for the firſt year are called "*Poults.*"

The grouſe inhabit thoſe mountains and moors which are covered with heath or "*heather*," and ſeldom or ever deſcend into the lower grounds. They fly in packs, conſiſting in general of four or five brace; and they love to frequent moſſy

places, particularly in the middle of the day, and when the weather is warm.

The old cock is known by the "*chocking*" noiſe he makes; and when the dogs point at a brood, he is commonly the firſt bird that goes off.

In purſuing this game, if, when the dogs are ſet, the ſhooter perceives the birds to erect their heads and run, he may be pretty certain they will not lye very well during the courſe of that day; and the only mode by which he will be enabled to get a ſhot at them, is, to run after them as faſt as he can, the moment that he perceives their heads, and, by this means, he will probably get near enough to ſhoot when they riſe upon the wing: this is found, by experience, to be the beſt method on thoſe days, when the birds, either from wet, or ſome other cauſe, will not lye well to the dogs.

As the ſeaſon for ſhooting this game commences in hot weather, and the birds, when ſhot, are ſubject to grow putrid in a ſhort ſpace of time, it is highly proper, eſpecially if they are wanted to be ſent to a diſtance,

that they be drawn carefully and extremely clean the very inſtant they are ſhot, and immediately afterwards ſtuffed with dry heather; and if the plumage happens to be wetted, by the fall to the ground, when the bird is ſhot, or by the tearing of the dogs, it muſt at the ſame time be wiped as dry as poſſible, before it is put into the game-bag. Before the birds are packed up to be ſent off, it is alſo proper to lay them within the moderate influence of a fire, for ſome minutes, in order to render them more perfectly dry.

THE WOODCOCK

IS a bird of paſſage, and commonly arrives in this country about the latter end of October.

This paſſage, in different ſeaſons, is more or leſs advanced or retarded, according as the wind and the weather happen to be, at the beginning of the autumn. The eaſt and north-

north-eaſt winds, and eſpecially when they are accompanied with fogs, bring them over in the greateſt numbers.

At their arrival on the firſt flight, they drop any where, as well under high trees, as in copſes, in hedge-rows, among heath and brambles; afterwards they take up their abode in copſes of nine or ten years growth, and ſometimes in thoſe little ſhaws, which, having been cut, are left to grow for timber; for it is but ſeldom that a woodcock is found in a young copſe of more than three or four years growth.

When we ſay they take up their abode, we muſt not be underſtood to mean, that they remain in the ſame wood during the whole of the winter; for it is obſerved, that they do not ſtay longer than twelve or fifteen days in one place; and that, if they do remain there for a longer ſpace of time, it is in conſequence of ſome wound or hurt received.

This bird riſes heavily from the ground, and makes a conſiderable noiſe with his wings. When he is found in an open field, in a hedge-row, or in the paſs of a wood,

he

he frequently only ſkims the ground, and then, his flight not being rapid, he is eaſily ſhot. But when he is ſprung in a tall wood, where he is obliged to clear the tops of the trees before he can take a horizontal flight, he ſometimes riſes very high, and with great rapidity; in this caſe it is difficult to ſeize the moment of ſhooting, by reaſon of the turnings and twiſtings which he is obliged to make, in order to paſs between the trees.

The woodcock walks very clumſily, as all birds are obſerved to do, which have great wings and ſhort legs. His ſight alſo is very bad, and particularly in the day-time. It is ſaid, however, that he ſees better in the duſk.

Shooting woodcocks, is a very pleaſant amuſement in woods which are not too thick; and if they are cut through in ſeveral places, it renders it more eaſy to ſhoot him in his paſſage when he ſprings in the wood, and alſo to mark him with greater certainty. Beſides, this ſport is more delightful and animating, as requiring a great noiſe and clamour with men and dogs.

There is a ſpecies of ſpaniels which give tongue

tongue when the cock ſprings, or when they get upon his haunt; theſe dogs are extremely uſeful, as they warn the ſportſman to be upon his guard.

Pointers, in general, ſtand at the cock, which is oftentimes very inconvenient; becauſe it cannot be known what is become of the dogs, or whereabouts they are; and as they will not come away when they are ſet, on being called or whiſtled to, the ſhooter has frequently to wait for them until his patience is exhauſted. To obviate this inconvenience in ſhooting cocks with pointers, ſome ſportſmen faſten a ſmall bell about the neck or the tail of each dog, by the ſound of which he may be followed in the wood; and when the ſound ceaſes, the ſhooter knows that the dog is on a point, and is thereby enabled to gueſs the place where the dog is.

In this ſport, it is very material to have a good marker. With this aſſiſtance, if the wood is ſmall, it will be difficult for a cock to eſcape; for it is known, that he will frequently ſuffer himſelf to be ſprung, and even

even ſhot at four or five times, before he will leave the wood to go to an adjoining one, or to a hedge-row.

During the day-time, the woodcock remains in thoſe parts of the woods where there are void ſpaces, or glades, picking up earth-worms and grubs from amongſt the fallen leaves. When night comes on, he goes to drink, and waſh his bill, at the pools and ſprings; after which, he gains the open fields and meadows, where he abides during the remainder of the night, and at break of day he returns to the wood.

The ſportſman may therefore advantageouſly watch at ſome opening, or cut which runs through the wood, and ſhoot him in his paſſage to and from it in the morning or evening flight; for it is remarkable, that whenever a woodcock ſprings from a wood to go into the open country, he always endeavours to find ſome paſs or glade, which he follows to its opening out of the wood; and when he returns back to the wood, he in like manner purſues a way for ſome time, and then turns to the right

or left, oppoſite ſome glade, in order to drop in the thick part of the cover, where he may be under ſhelter from the wind.

It is in theſe openings that nets are ſpread to take the woodcocks, in their morning and evening flights.

They may alſo be watched with advantage in the morning and evening flights, at thoſe narrow paſſes and little valleys on the edges of woods, which by their direction lead to ſome pool, ſpring, or head of a lake.

Thoſe who know the cuſtom which the woodcock has in the evening, of waſhing his bill in the pools which adjoin the woods, practiſe another method of killing them; which is, by watching near thoſe pools in the duſk of the evening, in order to ſhoot them as they alight.

The pools or ſprings, which are moſt frequented in this manner, are always known to the neighbouring peaſants; and it is eaſy to diſcover them on examination, by the marks of their feet on the margins.

Woodcocks remain in this country until the middle of March, and may be found all

all the winter ſeaſon, if the weather is not too ſevere. But if froſts happen which laſt for ſome time, they will almoſt totally diſappear at that interval, and a few only will be found by hazard, in certain places, where there are warm ſprings which do not freeze.

A month, or thereabouts, before their departure, it is common to ſee them in pairs at the morning and evening flights, and to hear them, when flying, make a ſmall piping noiſe, although, at other times, they are quite mute.

Since they are found in greater numbers in the month of March, than in the middle of winter, it is probable that they aſſemble at that time in order to go abroad.

Both woodcocks and quails have been known to breed in the ſouthern parts of this kingdom; but the inſtances are very rare.

Woodcocks are fatteſt in the months of December and January; but from the end of February, when they begin to pair, to the time of their departure, they are much leaner.

Pennant

Pennant, in the Supplement to his Arctic Zoology, informs us, that the female woodcock may be distinguished from the male by a narrow stripe of white along the lower part of the exterior web of the outmost feather of the wing. The same part, in the outmost feather of the male, is elegantly and regularly spotted with black and reddish white. In the bastard wing of each sex is a small pointed narrow feather, very elastic, and much sought after by painters as a pencil.

SNIPES

MAKE their appearance here in autumn, and remain until the spring. It is generally supposed, that they return into Germany and Switzerland to breed. Nevertheless, a great number remain with us during the summer, and breed in the marshes, where they lay their eggs in the month of June, to the number of four or five. Snipes are scarcely worth shooting until the first frost sets in; and in the month of November, they begin to grow very fat.

These

These little birds, when they abound, afford very excellent sport.

It is remarked, that snipes always fly against the wind, which is also the case with woodcocks; for this reason, it is best to hunt for them as much as possible with the wind to the back, because then they fly towards the sportsman, and present a fairer mark.

The snipe is generally esteemed difficult to shoot, by reason of the many turnings and twistings which it makes on being sprung: but this difficulty exists only in the minds of inexperienced sportsmen; for there are many birds more difficult to shoot flying. When once the shooter can accustom himself to let the snipe fly away, without his being in haste or alarmed, he will find that the flight is not more difficult to follow, than that of the quail; and it is better to let him fly to some distance, because the smallest grain of shot will kill him, and he will fall to the ground if struck ever so slightly.

Among the common snipes, some are larger than others. These are thought to be

be the males. Snipes, however, are ſometimes found, which, from their extraordinary ſize, muſt neceſſarily be of a different ſpecies; but theſe are ſo rare, that they do not here require a particular deſcription.

WILD DUCKS.

THIS race of birds, if we include all thoſe which have the ſhape and conformation of the duck, is extremely numerous, and there is no other bird which affords ſo many different ſpecies as this. But as of theſe, only the common wild ducks are found in conſiderable numbers in England, we will confine our deſcription to them alone.

Wild ducks alſo are birds of paſſage, and arrive here in great flights from the northern countries, in the beginning of winter. Still, however, a great many remain in our marſhes and fens, during the whole year, and there breed. They pair in ſpring, and lay from ten to fifteen eggs.

The duck commonly conſtructs her neſt

at the edge of the water, upon ſome tuft of ruſhes which is a little elevated, and begins to lay in March or April; her incubation is about thirty days, and the young ones are moſt commonly hatched in May.

The growth of their wings is very ſlow, and they attain more than half their ſize, before they are able to fly, which happens about the beginning of Auguſt, and near three months after the time of their being hatched.

The wild duck differs little in plumage from the tame duck, but is eaſily diſtinguiſhed by its ſize, which is leſs; by the neck, which is more ſlender; by the foot, which is ſmaller; by the nails, which are more black; and above all, by the web of the foot, which is much finer and ſofter to the touch.

The young ducks of the firſt year, are diſtinguiſhed from the old ones, by the feet, which are more ſoft and ſleek, and of a brighter red. They may alſo be known by plucking a feather from the wing; for if the duck is young, the root or end of the quill will be ſoft and bloody; if old, this

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extremity will be hard, without containing any bloody matter.

In the ſummer ſeaſon, when it is known that a team of young ducks are in a particular piece of water, and juſt beginning to fly, the ſportſman is ſure to find them early in the morning, dabbling at the edges of the pool, and amongſt the long graſs, and then he may get very near to them: it is uſual alſo to find them in thoſe places at noon.

By means of a little boat, they may be ſhot at any time of the day, and this method ſucceeds admirably well on ſmall pieces of water; for with the help of it they may all be killed. It will be ſtill more eaſy to effect this, if the ſportſman can contrive to kill the old duck; in that caſe, he may tie a tame duck by the leg with a piece of packthread to a pin of wood drove into the ground at the edge of the pool; this muſt be done in ſuch a manner, that the duck may be able to ſwim a little way into the water. He muſt then conceal himſelf within gunſhot. The duck will ſoon begin to "*quack*," and as ſoon as the young ones

hear her, they will come out to her, thinking it to be their mother.

If he wiſhes to take them alive, he has only to throw into the water near to the tame duck, a few fiſh-hooks tied upon pieces of twine, and baited with pieces of the lights of a calf. The lines muſt be faſtened to pickets placed at the edge of the water.

In the beginning of autumn, almoſt every pool is frequented by teams of wild ducks, which remain there during the day, concealed in the ruſhes. If theſe pools are of ſmall extent, two ſhooters, by going one on each ſide, making noiſes, and throwing ſtones into the ruſhes, will make them fly up; and they will in this way frequently get ſhots, eſpecially if the pool is not broad, and contracts at one end. But the ſureſt and moſt ſucceſsful way, is to launch a ſmall boat or *trow* on the pool, and to traverſe the ruſhes, by the openings which are found; at the ſame time making as little noiſe as poſſible. In this manner the ducks will ſuffer the ſportſmen to come ſufficiently near

them,

them to ſhoot flying; and it often happens, that the ducks, after having flown up, only make a circuit, return in a little time, and again alight upon the pool. Then the ſportſmen endeavour a ſecond time to come near them. If ſeveral ſhooters are in company, they ſhould divide, ſo that two ſhould go in the boat, whilſt the others ſpread themſelves about the edge of the pool, in order to ſhoot the ducks in their flight.

In pools which will not admit a trow, water-ſpaniels are abſolutely neceſſary for this ſport.

Another good way to ſhoot ducks in winter, and eſpecially in froſt, at which time they fly about, and are more in motion than at any other; is to watch for them in the duſk of the evening, at the margins of little pools, where they come to feed; they may then either be ſhot whilſt they are on the wing, or at the moment in which they alight on the water. When the froſt is very ſevere, and the pools and rivers are frozen up, they muſt be watched for, in

places

places where there are warm ſprings, and waters which do not freeze. The ſport is then much more certain, becauſe the ducks are confined to thoſe places, in order to procure thoſe aquatic herbs, which are almoſt the only food that remains for them at this period.

In times of great froſts, there are alſo ſmall rivers and brooks which do not freeze, and theſe afford abundant ſport. If the ſhooter follows the courſe of theſe waters at any time of the day, but particularly at an early hour of the morning, he will be certain to meet with wild ducks, which are then frequently lying under the banks, and among the roots of trees which grow on the edges, ſearching for cray-fiſh and inſects; and the ducks will not get up until he is cloſe upon them, and ſometimes they will even lye until he has gone paſt.

IN

IN the ornithological deſcriptions which we have given at the latter part of our work, we do not pretend either to the accuracy or the extent of the naturaliſt. We have contented ourſelves with preſenting ſuch a conciſe account as might be uſeful to the ſportſman, from being immediately connected with his amuſement.

Thoſe who wiſh to extend their reſearches farther into natural hiſtory, will find ample information in the work of the immortal *Buffon:* and thoſe who can be content with a ſmaller portion of knowledge on the ſubject, may find it in the leſs ſublime and leſs ſcientific works of Dr. Goldſmith and of Mr. Pennant.

But as the language of ſportſmen poſſeſſes a number of ſpecific names peculiar to itſelf, when ſpeaking of the various objects of their purſuit; it may not be improper to notice them in this place, and we give the terms as they are in our knowledge and acquaintance, and as we have been informed are proper.

Covey of partridge.
Nide of pheaſants (commonly called *a ni*).
Pack of grouſe.
Wiſp or whiſp of ſnipes.
Wing of plover.
Flock of geeſe.
Bevy of quails.
Flight of woodcocks.
Trip of dottrell.
Team of ducks.
Flock of buſtards.

ADDENDA.

ADDENDA.

SINCE the preſent work went to preſs, we have procured ſpecimens of the patent milled ſhot, as lately altered by the manufacturer, a circumſtance of caprice that we formerly noticed: to remedy this ridiculous inconvenience, we therefore here ſubjoin a table exhibiting the number of pellets compoſing an ounce weight in each particular ſize, in the ſame manner as before.

No.	B. B.	1 ounce - - -	60
	B.	id. - - -	67
	1.	id. - - -	86
	2.	id. - - -	109
	3.	id. - - -	160
	4.	id. - - -	200
	5.	id. - - -	256
	6.	id. - - -	444*
	7.	id. - - -	530
	8.	id. - - -	600

* There appears to be a great interval between the numbers 5 and 6.

F I N I S.